CALFED

TECHNICAL REPORT
AFFECTED ENVIRONMENT

RECREATION RESOURCES

Including Recreation Land Use; Recreational Opportunities; Fish, Wildlife, & Recreation Economics; and Social Well Being Related to Recreation

DRAFT

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CALFED
BAY-DELTA
PROGRAM

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LIST OF ACRONYMS

BCDC	San Francisco Bay Conservation and Development Commission
BLM	U.S. Bureau of Land Management
CALFED	CALFED Bay-Delta Program
cfs	cubic foot per second
Corps	U.S. Army Corps of Engineers
CPFV	commercial passenger-carrying fishing vessel
CVPIA	Central Valley Project Improvement Act
D-1485	Decision 1485
DBW	California Department of Boating and Waterways
Delta	Sacramento-San Joaquin Delta
DFG	California Department of Fish and Game
DPR	California Department of Parks and Recreation
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utilities District
MID	Modesto Irrigation District
MMWD	Marin Municipal Water District
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPS	National Park Service
NRA	National Recreation Area
NWR	National Wildlife Refuge
PEIS	Programmatic Environmental Impact Statement
PFMC	Pacific Fisheries Management Council
Protection Plan	Suisun Marsh Protection Plan
Reclamation	U.S. Bureau of Reclamation
RVD	recreation vVisitor day
SB	Senate Bill
SRA	State Recreation Area
SRA	State Recreation Area
SRCD	Suisun Resource Conservation District
SSWD	South Sutter Water District
SWRCB	State Water Resources Control Board
USFS	U.S. Forestry Service
USFWS	U.S. Fish and Wildlife Service
WMA	Wildlife Management Area
YCWA	Yuba County Water Agency

RECREATION RESOURCES

INTRODUCTION

This technical report describes recreation resources that could be affected by implementation of the CALFED Bay-Delta Program (CALFED). The report discusses recreation land use; recreational opportunities; fish, wildlife, and recreation economics; and social well being related to recreational economics.

Recreation resources in the CALFED study area include water-based and land-based activities and their supporting infrastructures.

Recreation Land Use

The recreation land use affected environment discusses open space and habitat, and the relevant regulatory context, historical land use trends, and existing general land uses and patterns for the study area. Table 1 indicates open space land acreages in all five CALFED regions.

Open space/habitat comprises those land uses designated as native lands and open water. Native lands include upland native vegetation, riparian and wetland vegetation, and barren lands. Open water includes lakes, reservoirs, rivers, and canals. Typical open space land uses include public parks, state recreation areas, wildlife refuges, and wildlife management areas.

Region	Approximate Acres of Open Space in Region	Percent of Region
Delta	247,900	29
Bay	2,133,435	75
Sacramento River	16,754,200	85
San Joaquin River	13,946,200	67
SWP and CVP Service Areas Outside the Central Valley	16,294,100	84
Total	**4,9375,835**	

SOURCES:
DWR 1991, 1994a, and 1994b.

Table 1. Open Space Land Use in All Regions

Recreational Opportunities

Recreation areas that could be affected by CALFED actions include:

- The Sacramento-San Joaquin Delta (Delta);
- Lakes and reservoirs;
- Rivers and streams located upstream and downstream of identified lakes and reservoirs;
- Coastal sport fisheries;
- National wildlife refuges (NWRs) and state wildlife management areas (WMAs); and
- Other facilities that provide limited recreation, such as aqueducts, canals, and private hunting clubs.

Commercial fishing areas in coastal water also are described under the discussion of fish, wildlife, and recreation economics because facilities and activities parallel those of sport fisheries.

Recreation characteristics are described for potentially affected recreation areas in all five CALFED regions. Information presented for these recreation areas includes summaries of the following:

- Type of recreation facilities and activities,
- Annual recreation use,
- Seasonality of recreation use,
- Recreation quality conditions associated with lake levels or river flows, and
- Origin of visitors.

Most activities at recreation areas in the Delta, Sacramento River, and San Joaquin River regions are water dependent or water enhanced. Water-dependent activities include boating, fishing, rafting, and swimming; water-enhanced activities include camping, picnicking, hunting, and wildlife observation.

The description of recreation activities in the Bay Region focuses on fishing activity for anadromous fish species. The description for the SWP and CVP Service Areas Outside the Central Valley is limited to recreation occurring at terminal storage reservoirs because they are the only recreation resources potentially affected by CALFED actions.

The term "consumptive use" refers to activities such as hunting and fishing. "Nonconsumptive use" denotes activities, such as boating and wildlife viewing, that do not involve the taking of game species.

Fish, Wildlife, & Recreation Economics

The affected environment for fish, wildlife, and recreation economics describes economic conditions pertaining to:

- Recreation at lakes and reservoirs, streams and rivers, wildlife refuges, and wildlife management areas, including water-dependent activities such as boating, fishing, rafting, swimming, hunting, and wildlife observation;
- Sport fishing for anadromous species such as salmon, steelhead, striped bass, and sturgeon in bays, estuaries, rivers, and coastal waters; and
- Commercial fishing for crayfish, shrimp, shad, striped bass, and salmon in bays, estuaries, rivers, and coastal waters.

The economic importance of recreational resources often is characterized by levels of recreation-related expenditures and recreation benefits. These indicators are used in this report to assess the economic importance of recreation at areas potentially affected by CALFED Program activities. Recreation-related expenditures are measures of trip-related spending by recreationists traveling to, and using, a specific recreational resource. Recreation benefits are a measure of social welfare or the value placed on recreation opportunities over and above actual expenditures; these values can be expressed in monetary terms. Table 2 shows the estimated economic effects of recreation for all five CALFED regions.

Unless otherwise noted, all dollar values shown in this report are expressed in constant 1995 dollars.

Region	Regional Expenditures[a] (millions of 1995 dollars)	Benefits[b] (millions of 1995 dollars)
Delta	$226.6	$159.9
Bay	$10.4	$8.7
Sacramento River	$76.8	$40.8
San Joaquin River	$56.8	$36.4
SWP and CVP Service Areas Outside the Central Valley	$132.0	$122.0

NOTES:

[a] Estimated primarily from 1992 recreation use information presented in this report.

[b] Measured in terms of user's willingness to pay for recreation opportunities.

SOURCE:
Jones and Stokes Associates staff estimate.

Table 2. Summary of Estimated Current Economic Effects Related to Recreation in All Regions

Social Well Being Related to Recreation

The affected environment for social well being related to recreation includes recreationists and recreation workers. Recreationists are boaters, sport fishers, hunters, and bird watchers who use reservoirs, rivers and streams, and wildlife refuges that store, convey, or use Delta water supplies. Sport and commercial fishing also occurs along the coastal area. Recreation workers are persons employed by service industries such as fishing guides, river guides, marina operators, boat repair businesses, and recreation supply businesses who provide gear and equipment for hunters, boaters, and fishermen. Members of this group generally are located along rivers that discharge to the Delta, and in Central Valley towns near CVP and SWP facilities, wildlife refuges, and rivers, and in coastal fishing communities. The affected environment for social well being also includes low-income and racial minority populations that may be disproportionately affected by CALFED actions that affect recreation uses or facilities.

SOURCES OF INFORMATION

Recreation Land Use

Information for the land use discussion in this report was compiled from a variety of sources, including the California Department of Water Resources' *California Water Plan Update* (1994b); existing technical studies; county general plans; and personal communications with offices of the state, regional councils of government, and counties.

Recreational Opportunities

Information for this report was compiled primarily from existing information in numerous reports generated by state, regional, and local agencies. These reports include the Delta Protection Commission's *Recreation Access Study* and various recreation use survey reports prepared by DWR. Supplemental information was gathered from resource management agencies such as the California Department of Boating and Waterways (DBW), California Department of Parks and Recreation (DPR), California Department of Fish and Game (DFG), U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS), U.S. Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers (Corps), East Bay Municipal Utility District (EBMUD), Yuba County Water Agency (YCWA), Modesto Irrigation District (MID), South Sutter Water District (SSWD), and other public and private operators of recreation facilities.

Fish, Wildlife, & Recreation Economics

Because of the lack of available annual recreation use data for the entire Delta area for most years, data gaps exist for large portions of the historical period. Estimates of recreation use in the Delta Region were used to estimate recreation trip-related spending and net recreation benefits.

Information from surveys conducted in the Delta Region by the USFWS (1993) and David M. Dornbusch & Company (1988), and in other recreation areas by Propst et al. (1992) was used to develop trip-related spending profiles of Delta recreationists. All trip-related spending by residents of the Delta Region was assumed to occur within the region. The percentage of trip-related spending in the Delta Region by nonresident recreationists was estimated based on the portion of the entire trip spent recreating in the Delta (66%). This percentage was based on survey data contained in Cajucom et al. (1980).

Information on recreation benefits derived from recreating in the Delta was obtained from existing economic studies on important recreation activities that may be affected by CALFED actions. Recreation benefits associated with sport fishing in the Delta Region were estimated from a travel-cost model developed by Roach and Loomis (1996). This model evaluated sport fishing for many Delta species and included the Sacramento River portion of the Bay-Delta as a site destination. A benefit of $14.50 (in 1995 dollars) per recreation visitor day (RVD) was estimated by calculating a weighted average of the benefits estimated for sport fishing in the Delta. For waterfowl hunting, benefits developed by Cooper and Loomis (1991) were averaged and updated to estimate a benefit of $26.06 per RVD. For all other recreation activities, a benefit of $27.72 per RVD was used. This estimate was developed for Delta recreational uses by Wade et al. (1987), using a travel-cost model that was updated to 1995 dollars.

The following sources were used to develop data and estimates for regions outside the Delta.

Information from surveys conducted by USFWS and NMFS was used to develop trip-related spending profiles for recreation users. All trip-related spending by local residents was assumed to occur in the regional economic area being visited, as was 80% of trip-related spending by nonresidents. Spending profiles and dollar values shown in this report are expressed in constant 1995 dollars unless otherwise noted.

Information on recreation benefits was obtained from existing economic studies on popular recreation areas that may be affected by CALFED actions. Data also were obtained from economic studies on recreation areas outside the study area to characterize potential recreation benefits to users of popular recreation areas.

The following assumptions were used to convert recreation-use levels to RVDs in the analysis:

- At all reservoirs, 12 recreation visitor hours are considered, on average, equal to one RVD.
- At all river recreation areas outside the Delta, 6 visitor hours are considered, on average, equal to one RVD.
- At all other areas outside the Delta, one visit is considered, on average, equal to one RVD.
- Historical use data (1940 to 1985) are generally presented in the form originally reported.

Information used in the commercial fishing section was obtained from publications and personal communications with agency staff and other knowledgeable individuals. The publications are as follows:

- The 1985, 1988, and 1992 Reviews of Salmon Fisheries (Pacific Fisheries

Management Council [PFMC] 1986, 1989, 1993a);

- *Historical Ocean Salmon Fishery Data for Washington, Oregon, and California* (PFMC 1993b); and
- *Fisheries of the United States, 1992* (NMFS 1993).

Information also was obtained from personal communications with staff from DFG and PFMC.

Data for the estimated weight (in pounds) of commercial fish landings in the Delta area were provided by DFG's Marine Statistical Unit (Eres pers. comm.). No information on the average price per pound or total value of commercial landings within the Delta area was available; therefore, no estimates of net income directly generated by commercial harvests were developed.

Social Well Being Related to Recreation

The primary source of information for this report was the Programmatic Environmental Impact Statement (PEIS) for the Central Valley Project Improvement Act (CVPIA) and the Fish, Wildlife, and Recreation Economics section of this report. Additionally, demographic data referred to in this report were obtained from the California Department of Finance.

ENVIRONMENTAL SETTING

Regulatory Context

RECREATION LAND USE

Both state and local planning jurisdictions govern land in the study area. The California State Legislature passed laws resulting in state policy that guides land uses in the study area, and local jurisdictions govern land use through general plans and the development review process. Several state and federal agencies also have jurisdiction for certain resources, such as water quality and biological resources.

The California State Legislature passed the Delta Protection Act of 1992, which created the Delta Protection Commission to provide regional coordination of the Delta. The Commission developed a long-term Land Use and Resource Management Plan for the 487,265-acre Primary Zone of the Delta (71% of the legal Delta) (Delta Protection Commission 1995).

The California State Legislature enacted the Suisun Marsh Preservation Act in 1974, which required that a protection plan be developed for the Marsh. The Act directed the San Francisco Bay Conservation and Development Commission (BCDC) and DFG to prepare the Suisun Marsh Protection Plan (Protection Plan) "to preserve the integrity and assure continued wildlife use" of the Suisun Marsh.

In 1978, the SWRCB issued Decision-1485 (D-1485), which set water salinity standards for Suisun Marsh from October through May to preserve the area as a brackish water tidal marsh and to provide optimum conditions for plant production as food for waterfowl. (DWR 1994b.)

The Suisun Resource Conservation District (SRCD) and DFG sponsored Senate Bill (SB) 1981, which required a long-range

protection plan for the Suisun Marsh. The enacted bill gave BCDC responsibility for implementation of the Protection Plan and SRCD local responsibility over habitat management practices in the Suisun Marsh.

The five primary counties of the Delta Region (Contra Costa, Sacramento, San Joaquin, Solano, and Yolo) organized the Delta Advisory Planning Council, which in 1976 produced the *Delta Action Plan and Watercourse Use Program*, a preliminary comprehensive resource plan and program for the Sacramento and San Joaquin Delta. The Delta Action Plan identifies a number of areas of significant recreational and scenic value.

RECREATIONAL OPPORTUNITIES

Recreation activities at reservoirs; sport fishing in rivers, in bays, and along the coast; and hunting activities are regulated to help manage these resources. The costs of regulating recreation resources and their uses are funded mostly through tax revenues and user fees. Management activities of resource agencies are funded through state and local general funds that are augmented by federal cost-sharing and user-collected revenues. License revenues from consumptive uses such as sport fishing and waterfowl hunting are important sources of management funds. Federal excise taxes on equipment used for recreation purposes, such as boats and fishing gear, and state and local sales tax revenues also are important revenue sources for resources management. Entrance fees collected at reservoirs and wildlife refuges provide important revenues for managing local recreation resources.

FISH, WILDLIFE, & RECREATION ECONOMICS

The Pacific Fisheries Management Council has regulated commercial salmon fishing in California since 1977. PFMC regulation, have substantially affected fishing in some regions by reducing the number of days allowed for fishing compared to the traditional season (May 1 to October 1). The North Coast Subregion is located in two management areas: the United States-Mexico Border to Horse Mountain Management Area and the Horse Mountain to Humbug Mountain Management Area (also known as the Klamath Management Zone). Commercial salmon fishing has been substantially limited in recent years to protect salmon originating from the Klamath River system. Commercial salmon fishing in the San Francisco and Central Coast Subregions is subject to regulations set for the United States-Mexico Border to Horse Mountain Management Area. (The California Coast subregions are discussed under the "Bay Region.")

SOCIAL WELL BEING RELATED TO RECREATION

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," (issued in 1994) is designed to focus the attention of federal agencies on the human health and environmental conditions in minority communities and low-income communities. It requires federal agencies to adopt strategies to address environmental justice concerns within the context of agency operations. In an accompanying Presidential memorandum, the President emphasizes that existing laws, including the National Environmental Policy Act (NEPA), provide opportunities for federal agencies to address environmental hazards in minority communities and low-income communities.

Executive Order 12898 and its accompanying memorandum have the primary purpose of ensuring that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority

populations and low-income populations ...". The Executive Order also explicitly calls for the application of equal consideration for Native American programs.

DELTA REGION

HISTORICAL PERSPECTIVE

Recreation Land Use and Opportunities. Prior to the 1850s, the Delta was an extensive tidal marsh that was subject to seasonal flooding. Since the 1950s, the land use trends in the Delta Region include a reduction in agricultural acreage, an increase in urban development and acreage, and the continued loss of open space lands.

Between 1976 and 1993, a significant amount of natural open space land (about 25,000 acres) was reclassified to agricultural land, two-thirds of which occurred in the Primary Zone. A similar amount of acreage was reclassified from agriculture to native land, with the majority occurring in the central part of the Delta (DWR 1993a).

Between 1976 and 1993, urban land in the legal Delta increased by approximately 22,700 acres, with the majority occurring in the Delta Secondary Zone. In 1993, about 44,400 acres of land were classified as urban land and 83,000 acres were classified as native land in the legal Delta—the majority of which were located in the Delta Secondary Zone and Delta Primary Zone, respectively. Since 1976, approximately 12,000 acres of native land, mostly in the Secondary Zone, was lost in the legal Delta (DWR 1993a). Table 3 summarizes the land use acreage changes between 1976 and 1993.

Although current agricultural practices include some cattle grazing and limited dry farming of grain crops where suitable soils exist, most of the reclaimed marshland has been converted to private duck clubs and state wildlife areas, both of which use the levee systems developed for agriculture as a management tool to provide habitat for wildlife (SRCD 1980).

Land Use	1976	1993	Net Change
Agriculture	541,820	527,309	-14,511
Urban	44,474	67,219	+22,745
Open Space	95,021	82,846	-12,175
Water Surface	57,178	61,119	+3,941

SOURCE: DWR 1993a.

Table 3. Land Use Acreage Changes Between 1976 and 1993 in the Legal Delta

Recreation use in the Delta has increased substantially over the past 45 years. In 1958 and again in 1963, recreation use was estimated at approximately 2.5 million RVDs, with a user-day representing one person spending a day or portion of a day in one particular type of activity (DWR 1958, 1963). By 1978, recreation use in the Delta was estimated at 7 million RVDs (Wade et al. 1987). Hunting, sport fishing, and water-dependent activities have continued to be important recreation activities in the region.

Before 1960, the majority of facilities available to boaters and other nonconsumptive-use recreationists centered on the use of commercial marinas and a limited number of city or county public access areas. Delta yacht or ski clubs were popular at this time and became instrumental in organizing and promoting waterborne recreation in the Delta. Some of these early clubs, including the Sacramento Yacht Club; the Stockton Yacht Club; and the Sportsmen, Inc. Yacht Club, were formed in the late 1920s and early 1930s. By the late 1950s, the number of available Delta recreation facilities had grown to approximately 127 different facilities, including 110 privately-owned commercial resorts, four publicly-owned parks, and 13 private clubs. (DWR 1966.)

The increasing demand for more Delta recreation opportunities spurred the state to establish Brannan Island State Recreation Area (SRA) in 1965 and Franks Tract SRA in 1966. Development of these SRAs enabled the state to collect fees for use of the areas and greatly enhance the level of recreational opportunities to include additional boating berths, campgrounds, picnic areas, and swim beaches. (Nelson pers. comm.)

Since the 1970s, as the demand for boating and nonconsumptive recreational opportunities continued to increase, various commercial marinas and boating clubs continued to be developed, including the Tower Park Yacht Club and the Discovery Bay Yacht Club.

Prior to World War II, the majority of waterfowl and pheasant hunting occurred on private farmland. After the war, the popularity of this sport brought an increasing number of hunters to private farmland. As Delta marshlands were drained and converted to agricultural use, land use conflicts with farmers spurred the development of alternative hunting areas, including Grizzly Island Wildlife Management Area (WMA), Joice Island WMA, and Sherman Island WMA, in addition to a variety of state cooperative hunting areas. Although private duck clubs and WMAs have remained popular hunting areas, the state cooperative hunting areas decreased in popularity during the 1960s (DWR 1966).

The Suisun Bay and Suisun Marsh portions of the Delta historically have been popular areas for waterfowl hunters. Past estimates of total annual waterfowl hunter-days in the marsh, including use of public hunting areas, range from approximately 48,000 to 62,000 per hunting season (DWR 1984, BCDC 1976). (An activity day is a day, or portion of a day, spent by one person in a given activity such as hunting.)

Recreational sport fishing historically has been a major activity in the Delta area, occurring throughout the year from shore locations, piers, and boats. Important sportfishing species include striped bass, shad, black bass, catfish, and steelhead. Although sturgeon and chinook salmon occur in the Delta area, these species are primarily caught in the San Pablo Bay and San Francisco Bay areas. Sport fishing for striped bass, American shad, and sturgeon is discussed below. Historical information on the sport fishing harvest of salmon caught in the Delta is unavailable.

Although commercial fishing for striped bass was abolished in 1935, a sport fishery was allowed to continue (Skinner 1962). By the early 1960s, a majority of the bass angling effort was concentrated in the Delta. Angling success for striped bass in the entire Bay-Delta region is shown in Table 4. Sport-catch records indicate a declining trend, with an average annual catch ranging from a high of 750,000 fish during the 1960s to a low of approximately 150,000 during the early 1980s.

American shad has continually been a popular sport fish; however, a sport fishery for this species did not become well established until 1957 (Skinner 1962). Although historical statistics on the shad sport fishery in the Delta have not been estimated, fishing for American shad has been described as being very good during this period (DFG 1979). One operator in the Delta estimated a catch of 30,000 fish by 2,500 anglers in 1954 (Skinner 1962).

Period	CPFV Catch	Total Catch
1960-1969	33,400	750,000
1970-1979	17,000	403,000
1980-1985	8,700	150,000

NOTES:

CPFV = Commercial passenger-carrying fishing vessel.

Historical striped bass catch data are for the entire Bay-Delta.

SOURCES:
DFG 1989, Leet et al. 1992.

Table 4. Historical Average Annual Sport Catch of Striped Bass in the Bay-Delta, 1960 to 1990

Commercial Fisheries. Crayfish have been commercially harvested in the Delta and sold locally for many years, and other species have been harvested for commercial consumption and sold as bait; however, harvest levels and related economic activity generated by commercial harvests have represented a minor segment of the regional economy.

Two studies have addressed the economic effects of recreational use of the Delta prior to 1990. Cajucom et al. (1980) summarized and evaluated the results of a Delta recreation survey conducted from 1977 to 1978. Based on the findings of the survey, the study estimated recreation use, spending profiles, expenditures, and recreation benefits for Delta recreationists. The Cajucom study estimated that recreational use of the Delta totaled 11.9 million RVDs from 1977 to 1978, and projected that annual use would increase to 12.9 million RVDs by 1985. Average expenditures per person per day were estimated to be approximately $16.50 for visitors to the Delta and $7.90 for residents of the Delta. Annual recreationist expenditures were estimated to total approximately $185.2 million. The study estimated annual recreation benefits to range from $550 to $686 million.

A study by Wade et al. (1987) revised the recreation use and economic estimates contained in the Cajucom study. This study arrived at new Delta recreation use estimates for 1977 to 1978 and for 1985 by revising the Cajucom study's estimate of visitor-group size, and excluding specific non-water-dependent recreation activities. The Wade study adjusted the estimated number of visits to the Delta for freshwater recreation to 6.4 million RVDs for 1977 to 1978 and 6.95 million RVDs in 1985. The economic value of freshwater recreation in the Delta in 1985 was estimated by Wade, using a travel-cost model. Recreation expenditures (out-of-pocket expenses and nonmonetary travel-time costs) were estimated to be $222 million based on 6.95 million RVDs. Net recreation benefits were estimated to be $193 million based on a net benefit per recreation day of $27.72.

DELTA REGION - CURRENT RESOURCE CONDITIONS

RECREATION LAND USE

Approximately 248,000 acres of native land (upland native vegetation, riparian and wetland vegetation, and barren lands) are located in the Delta Region, most of which occur along sloughs, rivers, and small channel islands in Contra Costa and San Joaquin counties (DWR 1991, 1994a). The more than 300,000 acres of open water in the study area are located throughout the Delta (DWR 1991, 1994a). Table 5 summarizes the types and amount of open space and native land in the study area.

Much of the open space in the Delta is used for public parks and wildlife refuges. DPR owns 5,000 acres in the Delta, including Brannan Island, an SRA since 1954; Franks Tract SRA (flooded) for recreation; Delta Meadows, a scenic waterway near Locke, popular with boaters; and over 1,000 acres in the Stone Lakes NWR (Delta Protection Commission 1995).

Type	Approximate Acres in Delta Region (% of area)
Upland native vegetation	33,200 (4%)
Riparian and wetland vegetation	97,100 (11%)
Open water (lakes, reservoirs, rivers, canals)	91,478 (11%)

SOURCES:
USFWS 1985; University of California, Santa Barbara 1991; and DWR 1991, 1994a.

Table 5. Open Space and Native Lands in the Delta Region

Significant amounts of acreage in the Delta Primary Zone have been purchased in recent years by state, federal, and nonprofit agencies for enhancement and management as wildlife habitat. For example, DFG owns 8,080 acres of land in the Delta Primary Zone including underwater land in the Lower Sherman Island Wildlife Area, portions of the Yolo Bypass, Woodbridge Ecological Reserve, Calhoun Cut Ecological Reserve, and Webb Tract, along with several small islands.

Today, the vast majority of Suisun Marsh is open space lands and wetlands (managed wetlands, tidal marshes, and seasonal marshes) (DWR 1994a). Approximately 59% of the total area within the statutory boundaries of Suisun Marsh is publicly owned by state and federal agencies; and approximately 41% is privately owned by hunting clubs and other landowners, including ranchers (SRCD 1980, Solano County Farmlands and Open Space Foundation 1989). DFG owns and manages approximately 15,300 acres in the Suisun Marsh. Grizzly Island WMA is open to the public for hunting seasons prescribed by the state. The 15,300-acre total also includes approximately 13,150 acres owned and operated by DFG for recreational uses. Areas in the marsh that are managed by DFG include portions of Grizzly Island and Joyce Island, Hill Slough Wildlife Area, Montezuma Slough, and Peytonia Slough Ecological Reserve.

RECREATIONAL OPPORTUNITIES

Water-dependent activities dominate annual recreation use in the Delta. These primarily boating-related activities include fishing from a boat, waterskiing, sailing, cruising, operating personal watercraft, canoeing and kayaking, houseboating, hunting from a boat, swimming from a boat, boat camping, swimming from shore, bank fishing, and windsurfing. Total boating use in the Delta in 1996 is estimated at 5.14 million boating days per year in the Delta.

Table 6 presents Delta recreation by activity showing its percentage of total use. Fishing and boating are the most populated activities in the Delta, accounting for approximately 70% of total use. Nonconsumptive uses in the Delta include camping and picnicking, walking for pleasure, bicycling, viewing and photographing wildlife, driving/sightseeing, and attending special events such as local fairs and festivals.

More than 75% of the recreationists using the Delta live in Contra Costa, San Joaquin, Sacramento, Alameda, and Solano counties. The majority of the remaining visitors live within a 100-mile radius of the Delta (DWR 1993b). Delta use patterns indicate that a majority of the visitors stayed 1 day or less in the Delta (Cajucom et al. 1980). Use varies from season to season. The peak recreation period occurs from May through September. Spring and summer (March to September) account for an estimated 75% of total annual use (DWR 1993b).

Delta recreation facilities tend to be close to each other and concentrated near major roadways. Popular access points for boating, waterskiing, and jet skiing include: Windmill Cove near State Route 4; King Island, Paradise Point, and Herman & Helens near Eight Mile Road; Tower Park near State Route 12; and Dels Boat Harbor near the city of Tracy.

Activity	Number of Visitor Days	% of Total
Boating[a]	2,224,000	32%
Boat and shoreline fishing	2,710,500	38%
Nonconsumptive use[b]	2,015,500	28%
Waterfowl hunting	120,200	2%
Total	**7,070,200**	**100%**

NOTES:

[a] Boating includes cruising, waterskiing, jet skiing, and sailing.

[b] Nonconsumptive uses include sightseeing, relaxing, camping, picnicking, swimming, and photography.

SOURCES:
DWR 1984, 1993a.

Table 6. Delta Recreation Use by Activity, 1985

Houseboating also is concentrated along Eight Mile Road (Moyer pers. comm.). Wind surfing, a fast-growing sport in the Delta, typically occurs along State Route 160 between Sherman Island and Rio Vista and at Windy Cove. Windy Cove is a new facility constructed at Brannan Island SRA and is the only formal wind surfing site in the study area (Brady & Associates 1994). The limited number of boating access points across the Delta and the lack of readily available rentals for ski boats and personal watercraft continue to be issues for recreationists (Moyer pers. comm.).

During the past 10 years, hunting has continued on private lands, as well as in public areas, in the waterways and on various small Delta islands (Jones & Stokes Associates 1995). Popular areas include Sherman Island WMA, Twitchell Island, Franks Tract SRA, and Clifton Court Forebay. In addition, the state owns 15,000 acres in Suisun Marsh at the western edge of the Delta, including approximately 6,000 acres of public hunting areas that compose the Grizzly Island and Joice Island WMAs.

Also during the last 10 years, existing regulations have closed the Joice Island WMA to hunting and set aside the area as a waterfowl sanctuary. Beginning with the 1994 to 1995 hunting season, however, selected areas of the WMA were opened to a maximum of 35 hunters per season (Becker pers. comm.).

Fishing access in the Delta primarily occurs from four designated access areas and from a variety of roadside locations and levee banks. Of all Delta sport fish species surveyed by DFG, striped bass was the most popular, with an average annual sport catch of 18,900, followed by American shad, salmon, and sturgeon (Table 7).

Recreation Facilities in the Legal Delta

Delta recreation facilities have been categorized as two types: public and commercial. Recreation facilities in Suisun Bay and Suisun Marsh are described separately following the discussion of recreation facilities in the legal Delta.

Approximately 23 public recreation facilities are located in the legal Delta. Three state agencies (DPR, DWR, and DFG) maintain nine recreation areas/facilities in the Delta. The remaining recreation areas are operated by county and city agencies.

Species	Angler Effort[a]	Sport Catch
Salmon	93,200	4,130
Steelhead trout	960	31
American shad	32,200	16,320
Striped bass	628,500	18,900
Catfish	64,200	12,000
Black bass	7,300	970
Sturgeon	249,400	1,500

NOTE:

[a] Angler effort is measured in the number of hours fishing for each species.

SOURCE:
DFG 1995.

Table 7. Average Annual Angler Effort and Catch for Selected Species in the Sacramento River Between the City of Sacramento and the Carquinez Bridge, 1991 to 1994

Recreation areas managed by DPR include Brannan Island SRA, Franks Tract SRA, and Delta Meadows River Park. Since 1986, annual attendance at all DPR facilities has averaged approximately 213,000 total visitors. Annual attendance for 1994 at DPR facilities was approximately 198,000 visitors.

Overall, use of the SRAs has been declining since the early 1990s. Annual attendance at all DPR recreation areas has dropped since 1989. Possible factors contributing to this decline

include drought conditions in the Delta area, a higher overnight camping fee, and a ban on alcohol consumption at the SRAs. However, 1995 estimates of attendance at DPR recreation areas indicate that overall attendance again has increased well above 1994 numbers (Nelson pers. comm.). It should be noted that use at the other SRAs is only an estimate of total use. Currently, on-site visitor counts are not made to accurately estimate total visits at these recreation facilities.

Sherman Island WMA is located in Sacramento County and is managed by DWR and DFG. Hunting use information is limited; however, approximately 870 hunters were selected to participate in the 1995 hunting season on these Delta islands. (DFG 1996.)

Clifton Court Forebay, managed by DWR and DFG, has a maximum capacity of 30 hunters and approximately 15 boats. Available use records indicate sporadic but increasing attendance at the Forebay from 1971 to 1980. Implementation of a self-registration system at the Forebay made use records after 1980 unreliable. Records after 1985 are unavailable because of repeated acts of vandalism, which forced the elimination of the self-registration system. (Gifford pers. comm.).

The majority of the other public facilities are relatively underdeveloped, providing only a launch ramp and water access for fishing.

Marinas account for most recreation facility types in the Delta, totaling approximately 120. Marinas provide many services in addition to boat berthing and boat fuel. These services include ski boat and houseboat rentals; boat services, such as boat launching and marine supplies; camping and picnicking facilities; guest docks and fuel stations; and food and beverage services.

Marinas are not equally distributed throughout the Delta but are concentrated in a handful of locations. The most heavily used areas include Bethel Island in Contra Costa County and Lower Andrus Island in Sacramento County. Bethel Island is congested with resorts, and 33 marinas provide 1,185 berths. In addition to marina berths, the private facilities at Bethel Island include a large number of support and service facilities. Andrus Island, by comparison, is more rural but provides nearly 1,700 berths. Roberts Island and Empire Tract King Island in San Joaquin County provide 998 and 719 berths, respectively. (Brady & Associates 1994).

Approximately 30 to 35 private waterfowl hunting clubs in the Delta Region total about 81,700 acres. Most private clubs are small, accommodating between eight and 16 hunters on a typical shoot day. Landowners manage private hunting clubs on Delta islands that, in some cases, are no longer in agricultural production. In 1995, approximately 200 people had memberships to private clubs (Jones & Stokes Associates 1995).

Recreational Facilities in Suisun Bay and Suisun Marsh

Suisun Bay and Suisun Marsh recreation facilities primarily are centered around the recreational activities occurring at Grizzly Island WMA and numerous private hunting clubs in the area. Fewer facilities are situated in this geographic region of the Delta compared to those identified above.

By far the greatest single use of the marsh devoted to a recreational activity, measured in recreation user-days and acreage, is waterfowl and upland game hunting that occurs at approximately 158 private hunting clubs. Approximately 43,610 acres, or nearly 90% of the total 50,000 acres of marshland area, are devoted to managing private waterfowl hunting clubs. Most of the clubs are managed mainly to maximize waterfowl habitat. Most of the private clubs are operated primarily during 59 days of the waterfowl hunting season, from October 24 to November 14, and from December 5 to January 10. Some clubs also are used for upland game hunting and as a meeting place for spring and summer recreation activities.

Waterfowl hunting at all the Suisun Bay and Suisun Marsh facilities averaged

approximately 13,700 hunter-days from 1986 through 1995.

The marsh's complex system of sloughs and bays provides substantial opportunities for fishing. Major sportfish species in the marsh consist of striped bass, black bass, and catfish. Opportunities for fishing include both boat and shore fishing, with most slough fishing done from the shore and bay fishing from boats. Public access to shore fishing is available at several facilities, including fishing areas at Hill Slough, the Belden recreational site on Grizzly Island Road, Chadbourne Road bridge on Chadbourne Slough, sites located in the Grizzly Island WMA, and a fishing pier at the Montezuma Slough control structure.

Recreation use for all fishing activities in the marsh, excluding bay fishing, is estimated at approximately 44,000 RVDs per year (DWR 1984). Estimates of fishing activities at the Grizzly Island and Joice Island WMAs indicate that between 1987 and 1992, fishing use at these wildlife areas (combined) averaged approximately 17,500 RVDs (DFG 1993). Approximately 90% of this use occurred at the Grizzly Island WMA.

Recreational boating takes place primarily on larger sloughs, including Suisun Slough, Hill Slough, Montezuma Slough, and the northern end of Goodyear Slough. The distribution and annual numbers of boaters on marsh sloughs are unknown. Public boat access to marsh sloughs is available at several marinas near Suisun City, at Pierce Harbor on Goodyear Slough, at the Montezuma Slough boat ramp, and from smaller public and private boat docks scattered on sloughs throughout the marsh. Types of boats found in the marsh include small outboard recreational and fishing boats, large inboard cabin cruisers, and small sailboats en route to Suisun Bay.

Passive recreational activities, such as picnicking, nature study, trail use, sightseeing, and dog training, are featured at state WMAs and Rush Ranch in Solano County. Rush Ranch, a 2,070-acre property on Grizzly Island Road, was acquired by the Solano County Farmlands and Open Space Foundation in 1980. The ranch was developed for recreational and educational purposes and features an interpretive program, approximately 7 miles of trails, and scheduled public nature tours.

Annual use of the total marsh for these passive recreational activities is unknown; however, nonconsumptive uses, including nature study, sightseeing, dog training, and miscellaneous activities at DFG wildlife areas, totaled approximately 9,000 RVDs during the 1995 to 1996 season.

Other recreational activities such as waterskiing, jet skiing, and other water sports, also take place on waterways throughout the marsh. Use of sloughs for these types of activities appears to be increasing. (Takacs pers. comm.).

FISH, WILDLIFE, & RECREATION ECONOMICS

Recreational use of the Delta generates both spending in the regional economy and benefits reflecting the value over and above what recreationists actually spend to travel to and use recreation areas.

Recreational use of the Delta annually generates an estimated 7.1 million RVDs. Recreationists visiting the Delta for sport fishing, boating, waterfowl hunting, and other recreation activities purchase goods and supplies at grocery and convenience stores, restaurants and bars, and service stations; stay at hotels, motels, and campgrounds; and use various recreation services. Based on the spending profiles presented in Table 8, recreationists spend an estimated $254.2 million annually to visit the Delta, including $226.6 million within the five-county Delta Region. Sport fishing in the Delta and Suisun Bay generate the largest portion of total spending by recreationists, accounting for 53% of total spending. Spending by recreation activity is presented in Table 8.

Recreation Activity	Annual Visitation (visitor days)			Trip-Related Spending per Visitor Day[c]	Annual Trip-Related Spending			Total Spending in the Delta Region[e]
	Resident	Nonresident[a]	Total[b]		Resident	Nonresident[d]	Total	
Sport fishing	$1,843,100	$867,400	$2,710,500	$49	$90,995,800	$42,821,600	$133,817,400	$119,258,100
Boating[f]	1,512,300	711,700	2,224,000	35.79	54,125,900	25,471,000	79,596,900	$70,936,800
Hunting	81,700	38,500	120,200	43.74	3,575,100	1,682,400	5,257,500	$4,685,500
Nonconsumptive uses[g]	1,370,500	645,000	2,015,500	17.65	24,190,000	11,383,500	35,573,500	$31,703,200
Total	**4,807,600**	**2,262,500**	**7,070,200**	**NA**	**$172,886,800**	**$81,358,500**	**$254,245,300**	**$226,583,600**

NOTES:

All values are expressed in 1995 dollars.

[a] Represents estimated use by nonresidents to Contra Costa, San Joaquin, Sacramento, Solano, and Yolo counties. Nonresident use was estimated based on a survey of Delta users (Cajucom et al. 1980), which indicated nonresident use accounted for approximately 32% of total use.

[b] Estimated based on annual use of 6,950,000 recreation visitor days (RVDs) for hunting, boating, and other nonconsumptive uses (Wade et al. 1987) and estimates of hunting days from Cajucom et al. (1980) and DWR (1994a). Total fishing, boating, and nonconsumptive RVDs were apportioned among these three categories of use based on information from DWR (1993a).

[c] SOURCES:
Freshwater fishing: USFWS and U.S. Bureau of the Census 1993.
Boating: David M. Dornbusch & Company 1988.
Waterfowl hunting: USFWS and U.S. Bureau of the Census 1993.
Nonconsumptive uses: Propst et al. 1992.

[d] Represents spending by nonresidents inside and outside the Delta Region.

[e] Represents estimated spending in the Delta Region (Contra Costa, San Joaquin, Sacramento, Solano, and Yolo counties). Includes 100% of spending by residents of the Delta Region and 66% of spending by nonresidents. Trip spending within the region by nonresidents was estimated based on the percentage of the trip spent recreating in the Delta (66%) (Cajucom et al. 1980).

[f] Includes motorboating, waterskiing, sailing, and houseboating.

[g] Includes relaxing, sightseeing, overnight camping, picnicking, swimming, photography, bicycling, and other nonconsumptive activities.

Table 8. Estimated Annual Recreation Trip-Related Expenditures in the Delta Region

Based on existing use of the Delta, recreation benefits annually accruing from Delta recreationists are estimated at $160 million (Table 9). Boaters and others engaged in nonconsumptive recreation activities account for the majority of recreation benefits.

Recreation Activity	Visitor Days[a]	Benefit per Visitor Day[b]	Total Benefits
Sport fishing	$2,710,500	$15.00	$39,302,300
Boating[c]	2,224,000	27.72	61,649,300
Hunting	120,200	26.06	3,132,400
Noncon-sumptive uses[d]	2015500	27.72	55,869,700
Total	**$7,070,200**	**NA**	**$159,953,700**

NOTES:

All values are expressed in 1995 dollars.

[a] Estimated based on annual visitation of 6,950,000 visitor days (Wade et al. 1987), estimated hunter days (Cajucom et al. 1980, DWR 1984), and percentages of visitation by activity in DWR (1993a).

[b] SOURCES:
Freshwater fishing: Jones & Stokes Associates based on Roach and Loomis 1996.
Boating: Wade et al. 1987.
Waterfowl hunting: Jones & Stokes Associates based on Cooper and Loomis 1991.
Nonconsumptive uses: Wade et al. 1987.

[c] Includes motorboating, waterskiing, sailing, and houseboating.

[d] Includes relaxing, sightseeing, overnight camping, picnicking, swimming, photography, bicycling, and other nonconsumptive activities.

Table 9. Estimated Annual Recreation Benefits Generated by Use of the Delta

COMMERCIAL FISHERIES

The Delta and Suisun Bay support the commercial harvest of crayfish and bait-fish species, such as bay shrimp and shad. Other species are harvested incidentally. Crayfish harvesting is the largest commercial fishing activity in the Delta Region. Crayfish are harvested in various locations throughout freshwater areas of the Delta, although most are offloaded at Stockton. Crayfish are sold for human consumption, and a portion of the harvest is exported. Most of the bait-fish harvest is sold locally for bait fishing (Ota pers. comm.). Based on commercial landing data for 1986 and 1995 provided by DFG (Eres pers. comm.), the commercial crayfish harvest in the Delta has remained relatively stable at about 12,000 pounds per year over the past 10 years (Table 10).

Species	Total Landings (in pounds) 1986	1995
Bay shrimp	–	3,884
Crayfish	11,991	11,990
Sablefish	NL	1,100
Salmon	NL	2,636
Shad	2,693	20,291
Sole	NL	17,757
Thornyheads	NL	7,840

NOTES:

– = Landings of species less than 1,000 pounds.
NL = No landings reported.

Pounds are reported as of port of landing. A portion of the commercial harvest shown in this table may have been caught outside the Delta and Suisun Bay.

SOURCE:
Eres pers. comm.

Table 10. Commercial Fish Landings in the Delta and Suisun Bay, 1986 and 1995

Bay Region

The Bay Region (Figure 1) includes coastal subregions affected by sport and commercial fishing. These subregions include the North Coast Subregion (Del Norte, Humboldt, and Mendocino counties), the San Francisco Subregion (Sonoma, Marin, San Francisco, and San Mateo counties), and the Central Coast Subregion (Santa Cruz, Monterey, and San Luis Obispo counties).

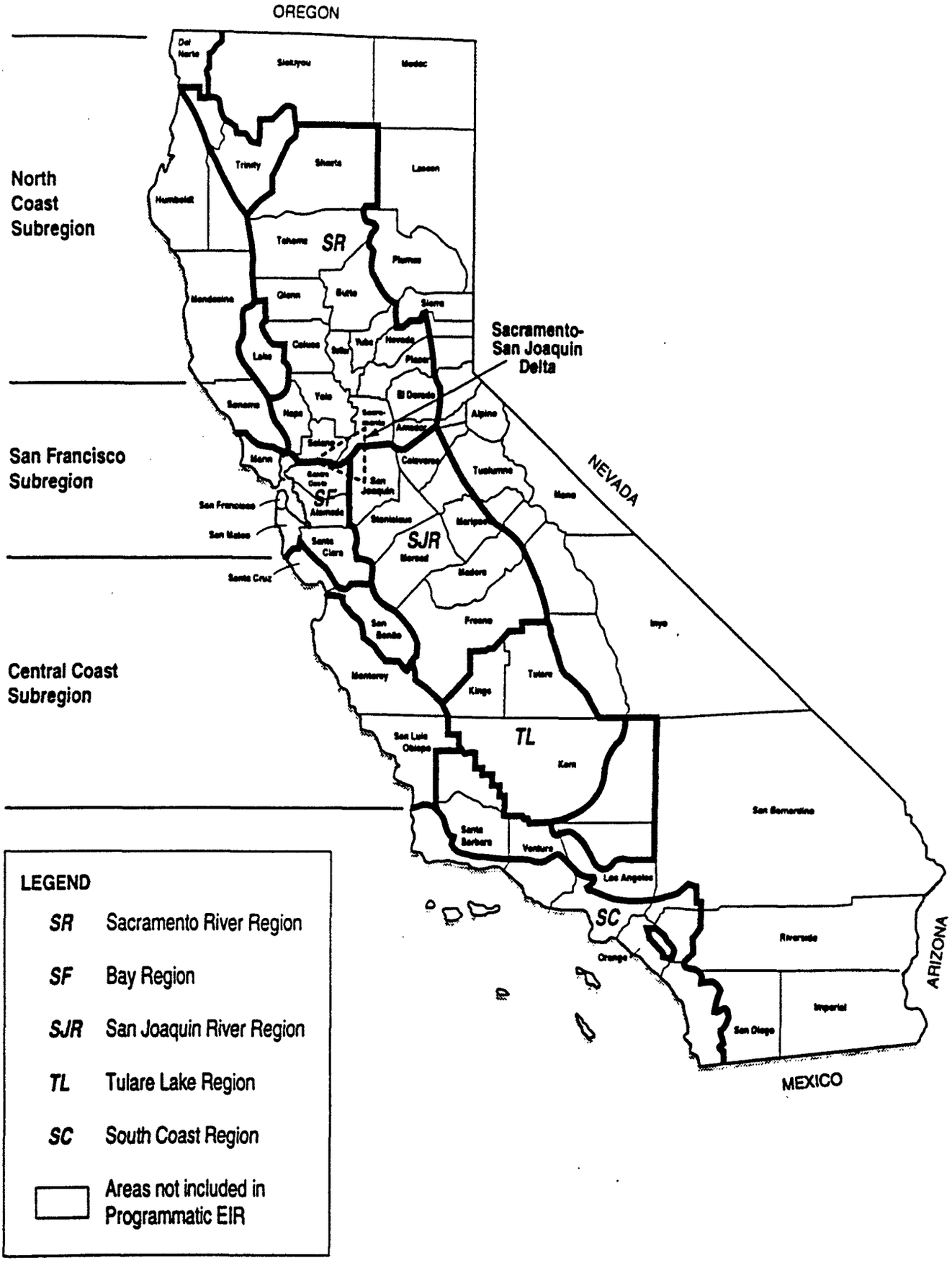

Figure 1. Coastal Subregions of Fisheries in the Bay Region

HISTORICAL PERSPECTIVE

This section focuses on the historical aspect of sport and commercial fisheries. Other recreation activities are not addressed in detail because they are not expected to be substantially affected by CALFED actions. The discussion of the trends in the region's sport fishery is based on historical data primarily gathered by DFG. Whenever possible, the discussion is based on fishing effort data; however, when effort data are not available, catch information has been substituted as an indicator of overall fishing success.

Sport Fishing. The San Francisco Bay Estuary supports the principal sport fisheries for salmon and striped bass in California. Important sport fishing use trends for these species in the Bay Region are:

- Sport catch of chinook salmon reached major peaks in 1955, 1968, and 1972, with annual landings of approximately 129,000, 128,000, and 152,000, respectively (Leet et al. 1992);

- Sport catch of chinook salmon reached lows in 1957, 1960, and 1978, with annual landings of approximately 44,700, 37,900, and 45,600 respectively (Leet et al. 1992); and

- Sport catch of white sturgeon fluctuated from a high of 2,300 fish in 1967 (Leet et al. 1992), to a low of 340 fish in 1977, and back to a high of 12,000 fish by 1985 (DWR 1990).

A sport fishery for striped bass was allowed to continue after 1935; however, by the early 1960s, most of the south San Francisco Bay was no longer producing striped bass and much of the bass angling effort shifted to the Delta area (Skinner 1962).

In 1954, following a 35-year moratorium on both commercial and sport fishing for sturgeon, a sport fishery in the Bay-Delta was reestablished (Skinner 1962). A majority of the fishery is concentrated in San Pablo Bay (Leet et al. 1992). Between 1954 and the mid-1960s, most sturgeon were taken incidentally by striped bass anglers. By the mid-1960s, the sport harvest of sturgeon began to increase dramatically.

Although exact sport-catch data for white sturgeon are not available, the catch rate for sturgeon is estimated to have increased by 40% over the last 2 decades (Leet et al. 1992). This increase suggests that fishing for sturgeon has become more popular as stocks of other game fish, such as striped bass, have declined. In response to increased angler success, catch regulations were modified.

Angling success for sturgeon was considered high from the mid-1960s through 1969. Total white sturgeon catch aboard commercial passenger-carrying fishing vessels (CPFVs) ranged from a low in 1964 to a high in 1967. Sturgeon fishing aboard CPFVs was not as successful in the 1970s, when total catch ranged from a high in 1970 to a low in 1977. In 1984 and 1985, total catch of white sturgeon was estimated at approximately 8,500 and 12,000 fish, respectively, based on abundance estimates.

The salmon sport fishery in California did not become important until after World War II, long after the commercial salmon fishery was established. Historically, the sport fishery has harvested approximately 14% of the salmon landed within the subregion, with commercial fishing accounting for 86%.

Commercial sport fishing vessels have played an important role in the history of ocean sport fishery, accounting for an estimated 65% of the total sport harvest of salmon in the California coastal areas. Most of these vessels originated from the San Francisco Bay area.

Chinook has been the most important salmon species caught in the California Coast subregion, accounting for 79% of the total salmon sport catch. San Francisco has been the most important subarea, yielding 67% of total sport landings between 1979 and 1985.

Ocean salmon sport fishing declined substantially between 1971 and 1985. For example, average annual days spent salmon sport fishing off the California coast decreased by 31% from 1976 to 1980 compared to effort from 1971 to 1975. Fishing days decreased by an additional 14% from 1981 to 1985. These declines were shared approximately equally between charter-boat fishing and private-boat fishing. Ocean salmon sport fishing activity increased during from 1986 to 1990, roughly returning to the 1971 to 1975 average level of effort.

Overall, recreation use related to sport fishing in the Bay Region has been declining over the historical period. Consequently, recreation expenditures and benefits associated with sport fishing also have decreased in their contribution to the local and regional economy. Subsequent declines in economic activity associated with potentially affected sport fisheries also is indicated by historical reductions in the number of commercial passenger-carrying fishing vessels (CPFVs) operating in the Bay Region. Approximately 35 charter vessels were in operation in 1970 compared to approximately 10 vessels in 1993 (Fraser pers. comm.).

Commercial Fisheries. Commercial landings of striped bass ceased after 1935 (when the commercial fishery for this species was closed), and American shad landings ceased after 1957 (when the Sacramento and San Joaquin rivers were closed to all commercial fishing). Salmon has dominated the anadromous fish harvest, even in years when other anadromous species were landed in significant numbers.

The ocean salmon fishery in California began operating in the 1880s in Monterey Bay. On average, approximately half of all commercial fishing vessels in California land salmon (56% during 1969 to 1993, 49% during 1982 to 1993). Since a limited-entry program was established for salmon in 1982, about 77% of all California vessels have been in possession of a salmon permit and 63% of all permit holders have actually landed salmon (landings are not required to retain the permit).

Between 1916 and 1943, ocean landings of chinook salmon in California ranged from 2.2 to 7.2 million pounds and averaged 4.5 million pounds per year. Landings experienced a general upward shift during 1944 to 1982, from 3.7 to 10.3 million pounds. Important factors contributing to this upward shift were the termination of gill-netting in inland waters in 1957 and the development of fish hatcheries in the American and Feather rivers in the 1960s. Annual chinook salmon harvest averaged 6.6 million pounds between 1967 and 1993, equivalent to approximately 575,000 fish.

Since 1983, the California chinook salmon fishery has experienced record high and low landings. Landings in 1983 (one of the most severe El Niño years of the century) were the lowest since 1939, totaling 2.4 million pounds. Landings subsequently increased to a record high of 14.8 million pounds in 1988 and declined to a new record low of 1.6 million pounds in 1992. Although landings increased to 2.6 million pounds the following year, 1993 was still one of the lowest landing years in the history of the chinook salmon ocean fishery (rivaled only by 1938 to 1939 and 1983). Landings, however, always comprise a substantial proportion of the chinook salmon population.

Approximately 10 to 20% of the fish caught in the commercial chinook salmon fishery in Oregon are from the Central Valley. Between 1952 and 1993, commercial landings of chinook salmon in Oregon, where the fishery is much smaller than in California, ranged from 53,000 to 530,000 pounds; California coastal landings over the same period ranged from 1.6 million to 14.8 million pounds. Landings in Oregon have been subject to wide fluctuations, similar to the variability of California landings. Oregon commercial salmon landings averaged 212,500 pounds during the 1967 to 1993 period.

A change that has occurred over the years has been the disappearance of spring-run chinook salmon from the ocean harvest. The preponderance of fish caught today in the commercial harvest are fall-run chinook salmon.

Another change has been an increasing proportion of hatchery fish in the catch, with recent estimates ranging from 30 to 40% overall, and as high as 86% on rivers with terminal hatcheries. Although this has served the hatcheries' initial purpose (to offset the loss to the populations of fish that would have spawned above major impoundments), it may contribute to the instability recently seen in ocean catch, with a boom-and-bust pattern of harvest dependent on survival of broods from a few major facilities.

During the most recent period (1986 to 1990), the nominal ex-vessel value (expressed in current-year dollars) of all salmon sold in the California Coast Region exceeded sales in the period from 1976 to 1980 by $5.4 million; however, real values declined compared with real values of the period from 1976 to 1980, averaging about $4.0 million less for the period from 1986 to 1990.

Table 11 shows the total pounds of salmon commercially landed by coastal subregion in 5-year increments. Except in the Central Coast Subregion, total pounds landed declined through the period from 1981 to 1985 compared with the period from 1971 to 1975. During the most recent period (1986 to 1990), pounds landed increased in all the subregions. Pounds landed increased the most (151%) in the San Francisco Subregion.

	Average Pounds of Salmon Landed (in millions)			
Subregion	**1971-1975**	**1976-1980**	**1981-1985**	**1986-1990**
North Coast	4.79	4.25	2.16	3.06
San Francisco	2.39	1.83	1.79	4.49
Central Coast	0.88	0.93	0.97	1.59
Total	**8.06**	**7.01**	**4.92**	**9.14**

SOURCE:
PFMC 1993b.

Table 11. Average Total Pounds of Salmon Commercially Landed Annually in the California Coastal Areas, 1971 to 1990

Table 12 shows the gross harvest value (in nominal and real terms) of salmon sold by region in 5-year increments. During the most recent period (1986 to 1990), the nominal gross harvest value (expressed in current-year dollars) of all salmon sold in the California Coastal Areas exceeded sales in the period from 1976 to 1980 by $5.4 million; however, real values declined compared with real values of the period from 1976 to 1980, averaging about $4.0 million less for the period from 1986 to 1990.

Since 1976, PFMC has estimated the personal income generated by the commercial salmon industry. These estimates include direct, indirect, and induced income derived from landing sales and salmon processing. Table 13 shows the income derived from the salmon industry compared with total regional personal income.

The San Francisco and Central Coast subregions show a very small percentage of income from the salmon industry compared with total personal income. The relatively large populations within these subregions help explain the relatively small percentages. Personal income from commercial salmon fishing in the North Coast Subregion approached 2% of total personal income in the region during the period from 1976 to 1980 but then fell more than 70% to 0.5% during the most recent period (1986 to 1990).

BAY REGION-CURRENT RESOURCE CONDITIONS

RECREATION LAND USE

Large undeveloped areas of land are found in the western, northern, and southern parts of the Bay Region. Federal and state parks and reservoirs make up a small portion of the total region.

Subregion	Nominal Value[a] (millions of dollars) 1971-1975	1976-1980	1981-1985	1986-1990	Real Value[b] (millions of dollars) 1971-1975	1976-1980	1981-1985	1986-1990
North Coast	NA	9.55	4.99	7.31	NA	18.35[c]	7.59	9.57
San Francisco	NA	3.91	4.33	9.70	NA	8.39[c]	6.60	12.29
Central Coast	NA	2.20	2.34	4.08	NA	4.26[c]	3.58	5.16
Total	**NA**	**15.66**	**11.66**	**21.09**	**NA**	**31.00**	**17.75**	**27.02**

NOTES:

NA = No information currently available.

[a] Value in current-year dollars.
[b] Value expressed in constant 1995 dollars.
[c] Based on average costs per pound for 1979 and 1980.

SOURCE:
PFMC 1993b.

Table 12. Average Gross Commercial Harvest Value of Salmon Landed at Ports in the California Coastal Areas, 1971 to 1990

Subregion	Income from Salmon (millions of 1995 dollars) 1976-1980	1981-1985	1986-1990	Total Regional Income[a] (millions of 1995 dollars) 1976-1980	1981-1985	1986-1990	Percentage of Income from Salmon (percentage of total income) 1976-1980	1981-1985	1986-1990
North Coast	32.5	13.1	16.2	1,632	2,351	3,291	1.99	0.56	0.50
San Francisco	17.5	13.9	24.8	45,894	56,084	63,408	0.04	0.02	0.04
Central Coast	7.6	4.7	9.2	14,933	18,944	22,071	0.05	0.02	0.04
Total	**57.6**	**31.7**	**50.2**	**62,459**	**77,379**	**88,770**	**0.09**	**0.04**	**0.06**

NOTE:

[a] Total regional income includes total income in the counties that constitute each region. Personal income estimate includes all direct, indirect, and induced income wages, salaries, and profits that are attributable to the salmon industry.

SOURCES:
PFMC 1986 and 1993b, U. S. Bureau of the Census 1992, California Department of Finance 1993, U. S. Bureau of Economic Analysis 1992 and 1993, and Seger pers. comm.

Table 13. Average Income Generated Annually by the Commercial Salmon Industry Compared with Total Regional Personal Income in the California Coastal Areas, 1976 to 1990

NWRs in the Bay Region include the San Francisco Bay NWR, the San Pablo Bay NWR, the Antioch Dunes NWR, the Ellicot Slough NWR, and the Farallon NWR. Public access is not allowed to the Antioch Dunes, Ellicot Slough, and Farallon NWRs; however, recreation in the form of wildlife viewing, hiking, and fishing is available at the San Francisco Bay and San Pablo Bay NWRs. Hunting also is allowed at the San Pablo Bay NWR. The economic activity associated with use of these NWRs has presumably increased as the demand for recreation has grown as a result of regional population growth.

RECREATIONAL OPPORTUNITIES

The Bay Region extends east from the Golden Gate Bridge and includes San Pablo Bay and San Francisco Bay. Although numerous recreation activities occur in San Francisco and San Pablo bays, this report focuses on water-dependent recreation. Other recreation activities are not addressed in detail because they are not expected to be substantially affected by CALFED actions.

Lakes and reservoirs operated by East Bay Municipal Utilities District (EBMUD) and Marin Municipal Water District (MMWD) are popular day-use destination sites for local residents. These lakes and reservoirs, and the surrounding parks, accommodate recreation activities year-round because of their proximity to major metropolitan areas. Those operated by San Francisco Water District do not substantially contribute to recreation use in the Bay Region because of access restrictions. Most visitation at Anderson Reservoir occurs between May and September.

As elsewhere in California, the quality of recreation at lakes and reservoirs in the Bay Region depends largely on surface water levels. During severe drawdown conditions, access to boat ramps and swimming areas is substantially reduced or eliminated. Water-enhanced activities, such as picnicking and hiking, also can be affected as water levels fall.

FISH, WILDLIFE & RECREATION ECONOMICS

Sportfishing activity in the Bay Region is associated with abundance, migration patterns, and fishing regulations. Sport fishing in the region occurs year-round.

Sport fishing occurs from private vessels, from CPFVs, and along the shore. The popularity of shore and boat fishing is associated with the type of sport fish being sought. Most fishing occurs aboard private vessels because CPFVs have become less popular. CPFV operators indicate a sustained decline in the popularity of fishing aboard these vessels, probably a result of the decline in the abundance of salmon and striped bass (Boydstrom pers. comm.). Although the exact number of CPFVs operating in the Bay Region is not known, an estimated eight to 12 CPFVs currently operate in San Francisco Bay (a substantial decline from the 30 to 40 CPFVs that operated in the 1970s); (Fraser pers. comm.). During this period, fishing from private vessels in the Bay Region has grown in popularity, probably because of growth in the local population (Fraser pers. comm.).

Striped Bass

Striped bass is the most important sport fish caught in San Francisco Bay (San Francisco Estuary Project 1992). Fishing for striped bass occurs aboard private vessels and CPFVs or from shore. An estimated 65% of total catch is made aboard private vessels, 21% from shore, and 14% from CPFVs (Leet et al. 1992).

Fishing for striped bass in the Bay-Delta closely follows the migration patterns of the fish (Leet et al. 1992). Generally, striped bass are found in greater numbers in San Pablo and San Francisco bays during summer and return to the Delta in fall. In spring, mature bass move upstream to spawn in the Sacramento and San Joaquin rivers (State Water Contractors 1987).

Most of the catch of striped bass in California occurs in the Bay-Delta, including San

Francisco Bay (35%), San Pablo Bay and Carquinez Strait (21%), Suisun Bay (6%), and the Delta (20%) (DFG 1989). An estimated 15% of total catch occurs in the Sacramento River upstream from Courtland, the remaining 3% in the ocean just outside the Golden Gate Bridge and in the San Joaquin River.

Recent DFG surveys show that approximately 23,358 striped bass were caught from July 1, 1992, to June 30, 1993, in the portion of the Bay-Delta between the Carquinez Bridge and Sacramento (Table 14). Striped bass was the most popular fish caught during this period, accounting for approximately 697,000 angler hours. Data for striped bass harvest in the entire Bay-Delta indicate that an estimated 61,800 fish were harvested in 1990 (Interagency Ecological Studies Program 1993).

The quality of striped bass angling in the Bay-Delta region depends on location, abundance, and regulations. During winter, striped bass are relatively inactive and fishing success is relatively low (Dumas et al. 1993). Fishing increases in spring as the fish begin to move up the Delta to spawn (Leet et al. 1992). The abundance of striped bass in the region probably is associated with Delta water diversions, Delta outflows, and water quality (DFG 1989). Although not directly affecting fishing success, size and possession limits can restrict total angling efforts for striped bass.

White Sturgeon

White sturgeon is one of the popular game fish sought in the Bay-Delta region. Although both green and white sturgeon are found, white sturgeon are more abundant because green sturgeon spend a greater portion of their lives in the ocean (San Francisco Estuary Project 1992).

Sturgeon are popular game fish because of their large size; however, they have one of the lowest catch rates per hour of angler effort for sport fish in the region. This catch rate is approximately one fish per 19 hours of fishing (Wixom pers. comm.).

		Effort	
Species [a]	Catch [b]	Angler Hours	%
Striped bass	23,358	696,723	57
Sturgeon	1,915	412,437	34
Salmon	2,730	79,541	6
American shad	26,535	38297	3
Total	**54,538**	**1,226,998**	**100**

NOTES:

[a] No steelhead were landed in the region during this period.

[b] Catch data are from July 1, 1992, to June 30, 1993.

SOURCE:
Wixom pers. comm.

Table 14. Catch of Selected Fish Species in the Bay-Delta, 1992 to 1993

Fishing trips for sturgeon are taken aboard both private vessels and CPFVs. A comparison of total sport catch of white sturgeon with catch reported by CPFVs for 1984, 1985, and 1987 indicates that approximately 8% of all white sturgeon are landed by private vessel operators (Leet et al. 1992, DWR 1990). The remaining 92% are caught aboard private vessels.

Sturgeon fishing continues year-round in San Pablo Bay, Suisun Bay, and the Delta. Fishing success in each area probably is associated with the movement of the fish in response to changing salinity conditions in the Bay-Delta region.

According to recent DFG surveys, approximately 1,915 sturgeon were caught from July 1, 1992, to June 30, 1993, between the Carquinez Bridge and Sacramento (Table 14). Of this total, an estimated 87% were released (Wixom pers. comm.). Angling effort for sturgeon during this period totaled approximately 412,400 angler hours.

The distribution of sturgeon in the Bay-Delta region is influenced by river flows into the Delta. Sturgeon are more likely to be found in the Suisun Bay area during dry years and in San Pablo Bay during wet years.

Salmon

Although salmon support a large sport fishery in the ocean, the salmon sport fishery in the Bay Region is small (Table 15) (San Francisco Estuary Project 1993). Salmon typically are caught in the area around the Golden Gate Bridge and upstream of Carquinez Strait. Salmon in the Bay-Delta region are caught aboard CPFVs and private vessels; a percentage breakdown of the total catch aboard these vessels is not available.

Saltwater sport fishing for salmon in the subregions composing California coastal areas accounted for an estimated 127,000 visitor days of recreation in 1992. Nearly 50% of the expenditures generated by sport fishing occurred in the San Francisco Subregion. Total use resulted in an estimated $10.4 million in trip-related expenditures (Table 15). Annual recreation benefits associated with this salmon sport fishing are estimated at $8.7 million, based on an average benefit of $70 per day.

Subregion	Regional Expenditures[a] (millions of 1995 dollars)	Benefits[c] (millions of 1995 dollars)
North Coast	2.1	2.1
San Francisco	5.5	4.2
Central Coast	2.8	2.4
Total	**10.4**	**8.7**

NOTES:

Economic effects were derived from 1992 information.

[a] Includes 80% of expenditures made by visitors from outside the local area and 100% of expenditures by visitors from the region.

[b] Measured in terms of users' net willingness to pay for recreation opportunities.

Table 15. Estimated Economic Effects Related to Salmon Sport Fishing in the California Coastal Areas

COMMERCIAL FISHERIES

Commercial ocean fishing economics is characterized by harvest values and net income received by the harvesting sector of the commercial fishing industry. Estimated current levels of ocean commercial harvest values and net income are summarized in Table 16.

Of all the anadromous fish species addressed in this report, only chinook salmon continues to support a commercial fishery. Commercial fishing for striped bass, sturgeon, and steelhead trout ended before development of the CVP. The commercial fishery for American shad officially ended in 1957 when most commercial fishing in the Bay and Delta was banned by the state legislature.

California Coast Subregions	Ocean Commercial Fishing Commercial Harvest Value of Salmon[a] (millions of 1995 $)	Related Effects Total Personal Income from Salmon[b] (millions of 1995 $)
North Coast	$0.1	$0.1
San Francisco	2.9	5.9
Central Coast	1.8	2.9

NOTES:

[a] Based on 1992 commercial harvest levels. Harvest values and income for the North Coast Subregion were very small in 1992 because of the closure of the Klamath Management Zone to commercial fishing.

[b] Includes all direct, indirect, and induced income (wages, salaries, and profits) attributable to the salmon industry in 1992.

SOURCE:
PFMC 1993a.

Table 16. Summary of Estimated Current Economic Effects Related to Commercial Fishing in the California Coastal Areas

In 1992, the North Coast Subregion accounted for less than 1% of the fishing effort, 1.3% of pounds landed, and 1.1% of the ex-vessel value of all salmon landed at ports in the three California coastal subregions. (Salmon fishing in the North Coast subregion was severely restricted to protect salmon populations in 1992.) The San Francisco subregion accounted for 32% of the fishing effort, 61% of the pounds of salmon landed, and 62% of ex-vessel value of all salmon landed at ports in the Pacific Coast Region. The Central Coast subregion accounted for 68% of the fishing effort, 37% of the pounds of salmon landed, and 37% of the ex-vessel value of all salmon landed at ports in the California Coast Region.

Two important indicators of the economic importance of the commercial salmon fishing industry are the relative poundage and ex-vessel value of salmon landed in proportion to the total pounds and value for all commercial seafood landed at ports in each subregion. In 1992, salmon accounted for 0.03% of the total pounds of seafood landed and 0.13% of the total ex-vessel value of seafood landed in the North Coast subregion. Salmon accounted for 2.0% of total pounds of seafood landed and 8.0% of the ex-vessel value of all seafood landed in the San Francisco subregion. Salmon accounted for 0.83% of the total pounds of seafood landed and 4.2% of the ex-vessel value of all seafood landed in the Central Coast subregion.

In 1993, the number of salmon fishing permit holders in California was 2,740, a 54 percent reduction from the 5,964 permit holders at the inception of the limited entry program in 1982. The percentage of salmon permit holders who actually fished for salmon also has declined over time, and the size of the fleet has declined to record low levels. The decline has been particularly acute for vessels that obtain a relatively significant amount of income (more than $5,000 annually) from salmon fishing, which accounts for 85% of the total revenue generated from the fishery.

A gradual aging of the fleet has occurred since the early 1980s, perhaps due to declining fishing opportunities. The state's limited entry program has also contributed to this aging by restricting the entry of new vessels into the fishery.

The relative amount of personal income generated by the salmon industry also indicates the economic importance of the industry to the region. In 1992, the salmon industry (including harvesting and processing activities) in the North Coast subregion generated $100,000 in personal income, which accounted for less than 0.01% of the total personal income generated in this subregion. In the San Francisco subregion, the salmon industry generated $5.9 million in 1992, which accounted for approximately 0.01% of the total personal income generated in this subregion and 66% of all income generated by the salmon industry in the three California coastal subregions.

In the Central Coast subregion, the salmon industry generated $2.9 million in 1992, approximately 0.01% of the total personal income generated in this subregion and 33% of all income generated by the salmon industry in the three California coastal subregions.

Fishing-dependent communities, as a whole, varied in the ability to adjust to the decline in anadromous fish populations. Communities in the southern and inland regions of the study area adjusted to the decline by turning to other industries for economic growth. However, communities in the northern region of the study area have had the most difficulty in making the transition to other industries.

Sacramento River Region

HISTORICAL PERSPECTIVE

Agriculture and open space historically have comprised the majority of land in the Sacramento River Region. Since the 1970s, however, urban land uses in the greater metropolitan Sacramento area have begun to supplant some agricultural uses.

Recreation opportunities in the Sacramento River Region have been shaped by the construction of large reservoirs and the alteration of major rivers. Construction of Shasta Lake, Whiskeytown Lake, Lake Oroville, Folsom Lake, New Bullards Bar Reservoir, and Englebright Lake provided extensive flatwater recreation opportunities. At the same time, historical recreation activities on the Sacramento, Feather, Yuba, and American rivers were affected as flows, water temperatures, and fisheries were altered by operation of the reservoirs.

Important reservoirs in the Sacramento River Region were completed between 1941 and 1970. Shasta Lake, which Reclamation completed in 1945, was the CVP's first major multipurpose facility. Initial recreation use did not occur until 1948, when the reservoir was filled (Reclamation 1976). The U.S. Forestry Service (USFS) began developing and managing flatwater and shoreline recreation resources at Shasta Lake after the Whiskeytown-Shasta-Trinity National Recreation Area (NRA) was established. Historically, Shasta Lake has been the most popular Reclamation lake or reservoir, with use ranging from 1.8 to 4 million RVDs annually between 1970 and 1985. (Petrinovich pers. comm.)

Whiskeytown Lake, constructed by Reclamation in 1963, also is located in the NRA, with recreation facilities managed by NPS. Between 1970 and 1985, annual recreation use at Whiskeytown Lake ranged from a low of 804,000 recreation days in 1974 to a high of 1.6 million recreation days in 1976 and then declined through the early 1980s. (Petrinovich pers. comm.)

Folsom Lake, completed in 1955, was the second major lake or reservoir constructed by Reclamation in the region. DPR manages the lake's recreation facilities. Visitation is not well documented between 1955 and 1970. After 1970, visitation declined from approximately 2 million to less than 1 million recreation days in 1977 but increased to nearly 2.8 million recreation days in 1985. (Petrinovich pers. comm.)

Lake Oroville, a part of SWP, was completed in 1968, with recreation facilities operated by DPR. Since 1968, visitor use has fluctuated substantially, ranging from 288,000 visitors in 1968 to 939,000 visitors in 1981. Visitation declined substantially in 1985 to 771,000 visitors. (DWR 1989.)

Other major lakes or reservoirs in the region include Englebright Lake (constructed by the Corps in 1941) and New Bullards Bar Reservoir (constructed by YCWA in 1970). Visitation at both has increased steadily from 1941 to 1985. Because Englebright Lake was constructed to control mining debris, recreation use did not begin until new techniques for controlling debris were developed in the early 1960s. From 1970 to 1985, annual visitation at Englebright Lake increased from 66,000 to nearly 116,000 visits. Recreation use at New Bullards Bar Reservoir increased steadily from 1970 to 1985, although historical records appear to understate the total amount of recreation known to have occurred at this facility.

Recreation activities along rivers in the Sacramento River Region were modified with the construction of dams on the Sacramento and Feather rivers. Before major dams were constructed, flows and water temperatures fluctuated seasonally. Low flows and relatively high water temperatures occurred in summer, and high flows and low water temperatures in winter. In some instances, modification to river flows resulted in substantial changes to sport fisheries.

Before Shasta Lake was built, summer flows in the Sacramento River were low, water temperatures rose above optimum ranges for salmonids, and only warmwater species were present below the dam site during summer (USFWS 1950). The most common summer gamefish in the river before construction of the lake were striped bass and catfish.

After Shasta Lake was constructed, water temperatures and flows in the river were altered to such a degree that a year-round salmonid sport fishery was created. Chinook salmon, steelhead trout, and rainbow trout

made the greatest contribution to the fishery (USFWS 1950). Its popularity is indicated by the growth in the number of recreation-related support services. On the reach of the river between Orland and Redding, the number of boat landings to serve the growing sport fishery increased from zero in 1945 to 11 in 1949. An estimated 46 establishments (such as resorts and bait shops) serving the sport fishery were in operation along the river in 1949 (USFWS 1950).

Between May 1948 and February 1949, an estimated 8,000 salmon and 3,800 rainbow trout and steelhead were caught on the reach of the river between Orland and Redding, with angler efforts of 171,300 and 43,200 hours, respectively (USFWS 1950). Between 1968 and 1975, an estimated annual average of 17,900 steelhead were landed by 31,900 anglers, and 17,500 salmon were landed by 24,300 anglers in the entire river (DFG 1980).

The Feather River below Lake Oroville and the Yuba River below Englebright Lake continued to support an important anadromous fishery, although not as extensive as that on the Sacramento River. Changes in water flow and temperature in the Feather River after completion of Lake Oroville did not substantially alter the number of fish species present in the lower portion of the river (DFG 1975). Averages based on angler surveys conducted from 1968 to 1974 indicate that 2,700 anglers caught 530 striped bass annually, 4,800 anglers caught 1,800 steelhead annually, and 4,500 anglers caught 644 chinook salmon each year (DFG 1980).

Wildlife refuges in the Sacramento River Region provide consumptive and nonconsumptive recreation opportunities. Opportunities for nonconsumptive recreation, which includes wildlife viewing, are provided at Sacramento and Colusa NWRs and Gray Lodge WMA. Opportunities for consumptive recreation, which includes fishing and waterfowl hunting, are provided at all wildlife refuges in the region.

Gray Lodge WMA, the first wildlife refuge in the Sacramento River Region, was established in 1931 (Reclamation 1989). Historically, Gray Lodge WMA has been the most popular of the five refuges in the region, accounting for approximately 61% of total use at all refuges in the region between 1973 and 1985. During this period, annual use averaged approximately 61,000 visitors per year, of which an estimated 24% were hunters (DFG 1993). Use at the refuge increased by approximately 95% between 1973 and 1985.

Sacramento NWR, established in 1937, historically has been the second most popular refuge in the Sacramento River Region, with an annual average of 29,200 visitors between 1973 and 1985 (Forrest pers. comm.). Nonconsump-tive uses accounted for approximately 73% of total use during this period.

Colusa NWR, established in 1944, has been the third most popular refuge in the region, with an annual average of 8,000 visitors between 1973 and 1985 (Forrest pers. comm.). Nonconsump-tive and consumptive uses historically have been equally popular at the refuge, each accounting for 50% of total use.

Sutter and Delevan NWRs, established in 1944 and 1963, respectively, have been used almost exclusively for hunting. Between 1973 and 1985, annual hunting activity averaged approximately 2,500 visitors at Sutter NWR and 5,500 visitors at Delevan NWR. (Forrest pers. comm.)

SACRAMENTO RIVER REGION - CURRENT RESOURCE CONDITIONS

RECREATION LAND USE

Land uses in the Sacramento River Region are principally agricultural and open space, with urban development focused in the city of Sacramento. More than half the region's population lives in the greater metropolitan Sacramento area.

Except for Sacramento County, the region generally contains large quantities of parklands, forests, and other open space, and has preserved its traditionally rural nature.

Overall, recreation use at important reservoirs, rivers, and wildlife refuges in the Sacramento River Region has paralleled increased population growth in the region. Consequently, recreation expenditures and benefits associated with increased use by visitors to the recreation areas have become an important contributor to the local and regional economy.

RECREATIONAL OPPORTUNITIES

Major recreation sites in the Sacramento River Region are the lakes and reservoirs, rivers and streams, and federal wildlife refuges and state WMAs. Waterfowl hunting on private lands is also a leading form of recreation in the region.

Table 17 shows a breakdown of the recreation areas in the Sacramento River Region that may be potentially affected by CALFED.

Major reservoirs in this region include Shasta Lake, Whiskeytown Lake, Lake Oroville, Folsom Lake, New Bullards Bar Reservoir, and Englebright Lake (Table 17). Major rivers and streams in the region include the Sacramento, Feather, Yuba, American, and Bear rivers, and Clear Creek. Other potentially affected lakes and reservoirs include Keswick Reservoir, Lake Red Bluff, Camp Far West Reservoir, Thermalito Forebay and Afterbay, Lake Natoma, and reservoirs located upstream of major reservoirs.

The Sacramento, Feather, and Yuba rivers and Clear Creek are important rivers and streams in the Sacramento River Region. Although complete data are not available to quantify trends in recreation use along each river, it can be assumed that most water-dependent and water-enhanced recreation activities along the rivers have increased with the population in the region. Where available, the most current data are used to provide an overview of recreation use in a particular area.

The recreation characteristics of these sites, and the use and activities at each are listed in Tables 18 and 19, respectively.

The Sacramento River Region includes federal wildlife refuges, state WMAs, and private hunting clubs (Table 18). These refuges and WMAs are treated as important recreation areas.

FISH, WILDLIFE, & RECREATION ECONOMICS

In 1992, recreation use at key recreation areas in the Sacramento River Region totaled approximately 3.6 million visitor days. It is estimated that approximately $77 million in trip-related spending resulted from this use, based on an average spending per visitor day (Table 20) of $17.65 for nonconsumptive activities at reservoirs, rivers, and wildlife refuges (primary activities associated with boating, swimming, and wildlife observation); $49.37 for sport fishing activities at reservoirs, rivers, and wildlife refuges; and $43.74 for waterfowl hunting at wildlife refuges (USFWS and U.S. Bureau of the Census 1993).

Recreation benefits are estimated at $40.8 million for 1992 (Table 21). This estimate is based on an average benefit of $10.43 per visitor day for reservoir recreation (Spectrum Economics 1991); $19.50 per visitor day for river recreation (Loomis and Ise 1992); and $22.75 per visitor day for recreation activities at wildlife refuges, which represents an average value for wildlife viewing and fishing activities (valued at $19.50 per day by Cooper and Loomis [1991]) and waterfowl hunting (valued at $26 per day by Cooper [1990]) at wildlife refuges.

	Recreation Area	Owner/Recreation Manager	Year Constructed/ Established
	Reservoirs and Lakes		
1	Shasta	Reclamation/USFS	1945
2	Whiskeytown	Reclamation/NPS	1963
3	Keswick	Reclamation/Shasta County	1945
4	Lake Red Bluff	Reclamation/Reclamation	1966
5	Lake Oroville	DWR/DPR	1968
6	Thermalito Forebay	DWR/DPR	1968
7	Thermalito Afterbay	DWR/DFG	1968
8	Folsom	Reclamation/DPR	1955
9	Natoma	Reclamation/DPR	1955
10	Englebright	Corps/Corps	1941
11	New Bullards Bar	YCWA/USFS	1970
12	Camp Far West	SSWD/Private concessionaire	1963
	Rivers		
13	Sacramento	NA/BLM, Reclamation, DPR, Counties, Private	NA
14	American	NA/DPR; Sacramento County	NA
15	Feather	NA/private	NA
16	Yuba	NA/private	NA
17	Clear Creek	NA/NPS, private	NA
18	Bear	NA/private	NA
	Wildlife Refuges		
19	Sacramento NWR	USFWS/USFWS	1937
20	Delevan NWR	USFWS/USFWS	1962
21	Sutter NWR	USFWS/USFWS	1944
22	Colusa NWR	USFWS/USFWS	1944
23	Gray Lodge WMA	DFG/DFG	1931

NOTES:

BLM = U.S. Bureau of Land Management.
Corps = U.S. Army Corps of Engineers.
DFG = California Department of Fish and Game.
DPR = California Department of Parks and Recreation.
DWR = California Department of Water Resources.
NA = Not applicable.
NPS = National Park Service.
NWR = National Wildlife Refuge.
Reclamation = U.S. Bureau of Reclamation.
SSWD = South Sutter Water District.
USFS = U.S. Forest Service.
USFWS = U.S. Fish and Wildlife Service.
WMA = Wildlife Management Area.
YCWA = Yuba County Water Agency.

SOURCES:
California Department of Finance 1991; Reclamation 1989, 1993a.

Table 17. Potentially Affected Recreation Areas in the Sacramento River Region

Recreation Areas	Surface Area or Length (acres or miles)	Number of Major Facilities: Marinas	Boat Launches	Picnic Areas	Camp-grounds	Swimming Areas	Activity Restrictions	Primary Game Fish
Key Areas								
Reservoirs and Lakes								
Shasta	29,500	13	6	1	22	0	Swimming/boat speed restrictions	C/RT/SB
Whiskeytown	3,250	1	3	0	3	2	Boat speed restrictions in coves	KS/RT
Oroville	15,800	2	3	3	9	1	None	BT/CF/KS/LB/RT/SB
Folsom	11,450	1	8	5	4	1	None	C/CF/RT/SB
New Bullards Bar	4,810	1	2	1	4	0	No skiing along shore	KS/LB/RT/SB
Englebright	760	2	4	1	17	0	No skiing in upper portion of lake	KS/LB/RT/SB
Rivers and Creeks								
Sacramento								
Upper Reach	60	6	8	8	1	0	None	CS/RT/SH
Middle Reach	160	19	19	11	21	0	None	AS/CS/RT/S/SH/STB
Lower Reach	80	24	13	7	4	1	None	AS/CF/CS/S/SH/STB
Feather	40	0	3	0	0	0	None	AS/CS/ST/STB
American	23	1	16	12	0	0	None	AS/CS/RT/SH/STB
Yuba	20	0	0	0	0	0	Activity restricted on private lands	AS/CS/SH
Clear Creek	17	0	0	0	0	0	Activity restricted on private lands	CS/RT
Wildlife refuges [a]	25,580	0	0	0	0	0	Limited access during waterfowl season	CF/LB
Private hunting clubs	227,027	0	0	0	0	0	None	NA
Other Potentially Affected Areas								
Reservoirs								
Keswick	640	0	1	0	0	0	None	C/RT/SB
Lake Red Bluff	530	0	1	1	1	0	Reservoir drained in winter	CS
Camp Far West	2,680	1	2	2	2	2	None	BB/C/SB
Rivers								
Bear	20	0	0	0	0	0	Dewatered in summer	CF/SB

NOTES:

Fish code letters:

AS = American shad	CF = catfish	NA = not applicable	SH = steelhead trout
BB = black bass	CS = chinook salmon	RT = rainbow trout	STB = striped bass
BT = brown trout	KS = kokanee salmon	S = sturgeon	
C = crappie	LB = largemouth bass	SB = smallmouth bass	

[a] Wildlife refuges include Sacramento NWR (10,800 acres), Delevan NWR (5,600 acres), Sutter NWR (2,600 acres), Colusa NWR (4,040 acres), and Gray Lodge WMA (2,540 acres). Fishing at wildlife refuges is allowed only at Delevan NWR and Gray Lodge WMA.

[b] Private hunting clubs number approximately 516 throughout the Sacramento River Region.

SOURCES:

Reservoirs and Lakes:
- Shasta: USFS 1990, Reclamation 1992a.
- Keswick: Reclamation 1986, 1992a.
- Whiskeytown: Reclamation 1992a.
- Red Bluff: Reclamation 1992b.
- Oroville: DPR 1988.
- Folsom: Corps 1991, DPR 1989.
- New Bullards Bar: YCWA 1993.
- Englebright: Corps 1992a.
- Camp Far West: YCWA 1993, Melton pers. comm.

Rivers:
- Sacramento: Reclamation 1990, DWR 1982, and Wixom pers. comm.
- Feather: Wixom pers. comm.
- American: Corps 1991, BLM 1990.
- Yuba: DFG 1991a.
- Clear Creek: DWR 1986.
- Bear: Melton pers. comm.

Wildlife Refuges: Reclamation 1993a, USFWS 1992a.

Private Hunting Clubs: DFG 1994*[a?]*.

Table 18. Recreation Characteristics of Key and Other Potentially Affected Recreation Areas in the Sacramento River Region

Recreation Areas	Use (1,000) [a]	Water-Dependent Activities (%)					Water-Enhanced Activities (%)					
		Power Boating	Other Boating	Fishing	Water-skiing	Swimming and Beach Use	Camping	Picnicking	Sight-seeing	Resorts	Other	Total
Key Areas												
Reservoirs and Lakes												
Shasta	2,422	31	3	12	10	--	9	--	3	16	16	100
Whiskeytown	279	23	--	6	7	24	20	3	15	--	2	100
Oroville	418	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Folsom	362	29	5	20	--	27	4	9	--	--	6	100
New Bullards Bar	52	29	--	--	--	--	70	1	--	--	--	100
Englebright	92	33	--	21	14	15	11	6	--	--	--	100
Rivers [b]												
Sacramento												
Upper Reach	35	3	9	26		6	11	11	26	--	8	100
Middle Reach	42	7	10	49	2	12	8	2	7	--	5	100
Lower Reach	84	16		43		10	5	6	17	--	1	100
Feather	89	--	--	100	--	--	--	--	--	--	--	100
American	27	--	12	10	--	10	--	--	53	--	15	100
Yuba	2	--	--	100	--	--	--	--	--	--	--	100
Clear Creek	1	--	--	--	--	49	--	--	42	--	9	100
Wildlife refuges [c]	103	--	--	4	--	--	--	--	73	--	23	100
Private hunting clubs [d]	935	--	--	--	--	--	--	--	--	--	100	100
Other Potentially Affected Areas												
Reservoirs and Lakes												
Keswick	0.5	--	--	70	--	--	--	--	20	--	10	100
Red Bluff	86	2	--	7	3	1	42	2	25	--	18	100
Camp Far West	72	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Rivers												
Bear	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

NOTES:

-- = No use reported in these categories.
NA = No information currently available.

[a] Use at all reservoirs is reported in 12-hour recreation visitor days (RVDs), at rivers is reported in 6-hour RVDs, at wildlife refuges is reported in 6-hour RVDs, and at private hunting clubs is reported in visits. Use data for rivers include fishing only.
[b] All use figures are 1992 data except for Clear Creek (1980).
[c] Wildlife refuges are Sacramento NWR, Delevan NWR, Sutter NWR, Colusa NWR, and Gray Lodge WMA.
[d] Includes approximately 516 clubs throughout the Sacramento River Region.

SOURCES:

Reservoirs and Lakes:
- Shasta: use (Reclamation 1992b), activity (USFS 1993).
- Whiskeytown: use (Reclamation 1992b), activity (Reclamation 1981).
- Oroville: use (Goswick pers. comm.).
- Folsom: use (Erba pers. comm.), activity (DPR 1989).
- New Bullards Bar: use (Reclamation 1992b), activity (YCWA 1993).
- Englebright: use (Corps 1992a), activity (Corps 1992*[a or b?]*).
- Keswick: use (Reclamation 1992b), activity (Reclamation 1981).
- Red Bluff: use (Reclamation 1992b), activity (Reclamation 1979).
- Camp Far West: use (Higley pers. comm.), activity (YCWA 1993).

Rivers:
- Sacramento: use and activity (DWR 1982).
- Feather: use (Wixom pers. comm.).
- American: use and activity (Corps 1991).
- Yuba: use (Wixom pers. comm.).
- Clear Creek: use and activity (DWR 1986).
- Bear: use and activity (Melton pers. comm.).

Wildlife refuges: use (DFG n.d., Forrest pers. comm., and Reclamation 1993a), activity (Forrest pers. comm.).
Private hunting clubs: use (DFG 1992).

Table 19. Recreation Use and Activities at Key and Other Potentially Affected Recreation Areas in the Sacramento River Region

Business Sector	Freshwater Fishing[b]	Saltwater Fishing[a]		Waterfowl Hunting[b]	Nonconsumptive Recreation Uses[c]
		Charter	Private		
Food stores	5.08	3.78	4.31	5.31	3.14
Eating and drinking establishments	10.32	7.57	8.64	12.65	2.35
Service stations	17.83	12.97	26.07	13.18	3.95
Hotels and motels	10.43	7.56	8.62	4.89	5.06
Miscellaneous retail	5.71	73.82	24.58	6.71	3.15
Total	**49.37**	**105.70**	**72.22**	**43.74**	**17.65**

NOTES:

Values are in 1995 dollars per visitor day.
Expenditure estimates were adjusted to constant 1995 dollars using the Consumer Price Index.

SOURCES:
[a] Thomson and Huppert 1987.
[b] USFWS and U.S. Bureau of the Census 1993.
[c] Propst et al. 1992

Table 20. Average Trip-Related Expenditures by Principal Recreation Activity and Spending Category in the Sacramento River Region

Recreation Area	Regional Expenditures[a] (millions of 1995 dollars)	Benefits[b] (millions of 1995 dollars)
Lakes		
Shasta	46.7	25.3
Oroville	7.1	4.3
Folsom	8.5	3.8
Rivers[c]		
Sacramento	7.5	3.1
Feather	3.3	1.3
American	1.3	0.5
Yuba	0.1	0.04
Wildlife refuges	2.3	2.4
Total	**76.80**	**40.78**

NOTES:

Annual expenditures and benefits are estimated from 1992 use information.

[a] Includes 80% of expenditures made by visitors from outside the region and 100% of expenditures made by visitors from inside the region.

[b] Measured in terms of users' net willingness to pay for recreation opportunities.

[c] Includes only sport fishing activities.

Table 21. Estimated Annual Expenditures and Benefits Related to Recreation Use at Popular Sacramento River Region Recreation Areas

Environmental Setting - San Joaquin River Region

HISTORICAL PERSPECTIVE

Most of the major lakes and reservoirs in the San Joaquin River Region were completed in the 1960s and 1970s. Table 22 lists the major recreation areas, the owner/manager, and the year the area was constructed.

Prior to the 1960s, land uses in the San Joaquin River Region were principally agriculture and open space, with urban uses limited to small farm communities. Open space uses, including national forest and park lands, state parks and recreational areas, and U.S. Bureau of Land Management (BLM) and military properties, historically have comprised about one-third of the region.

Important use trends at CVP facilities in the San Joaquin River Region are as follows:

- Recreation use at San Luis Reservoir increased from an estimated 33,000 visits

in 1967 to an estimated 282,000 visits in 1985.

- Annual recreation use at Millerton Lake increased from an estimated 574,000 visitor days in 1970 to an estimated 667,000 visitor days in 1985.

- Annual recreation use at New Melones Reservoir, completed in 1979, increased from an estimated 250,000 visitor days in 1980 to an estimated 499,000 visitor days in 1985.

No historical use data are available for Lake Camanche; however, important use trends at other non-CVP facilities in the San Joaquin River Region are as follows:

- Annual use at Lake McClure increased from an estimated 167,700 visits in 1969 to an estimated 428,000 visits in 1985.

- Recreation use at New Don Pedro Reservoir increased from an estimated 300,000 visits to an estimated 501,000 visits in 1985.

- Recreation use at New Hogan Lake increased from an estimated 5,100 visitor days in 1963 to an estimated 262,000 visitor days in 1985 (Lykins pers. comm.).

CVP reservoirs and non-CVP reservoirs, rivers, and wildlife refuges in the San Joaquin River Region support a variety of recreational activities, including sport fishing, hunting, boating, camping, swimming, picnicking, and sightseeing. Most of the reservoirs supporting recreational uses in the San Joaquin River Region were completed in the 1960s and 1970s. Overall, recreation use data are limited.

In 1962, DFG estimated that the Stanislaus River chinook salmon run supported an average annual use of 10,000 angler days of sport fishing. Although no other information or use data on angling or nonconsumptive recreation for the Stanislaus River and other important rivers in the San Joaquin River Region has been located, the river most likely supported other nonconsumptive recreation pursuits such as swimming, boating, camping, and picnicking.

Important wildlife refuges in the San Joaquin River Region include Los Banos and Volta WMA; and Kern, Kesterson, Merced, Mendota, Pixley, and San Luis NWRs. Historical use data for NWRs are not available; however, overall use trends at the NWRs probably resemble trends at the WMAs. For example, recreation use at Los Banos WMA and Volta WMA increased from an estimated 36,400 visitor days in 1973 to an estimated 69,305 visitor days in 1985. Recreation opportunities for both nonconsumptive and consumptive activities are provided at all wildlife refuges in the region.

Recreation activities associated with rivers in the San Joaquin River Region were modified as dams were constructed on the San Joaquin, Stanislaus, Tuolumne, Merced, and Calaveras rivers. Millerton Lake on the San Joaquin River modified the flows and temperature of the river. Mean monthly river flows before construction of the dam ranged from 1,000 cubic feet per second (cfs) in October to more than 5,000 cfs in April and May (Jones & Stokes Associates 1976). During the irrigation season, however, the river was diverted substantially, creating hazards for chinook salmon, steelhead trout, striped bass, American shad, and sturgeon (Jones & Stokes Associates 1976).

The Stanislaus River downstream of Goodwin Dam historically supported resident populations of warmwater game species, including largemouth and smallmouth bass, channel and white catfish, black crappie, bluegill, and green sunfish. Historical anadromous fish populations below Goodwin Dam included chinook salmon, steelhead, striped bass, American shad, and sturgeon. Salmon production in the Stanislaus River contributed to sport and commercial catches in the ocean and lower San Francisco Bay (Jones & Stokes Associates 1976).

	Recreation Area	Owner/Recreation Manager	Year Constructed/ Established
	Reservoirs and Lakes		
1	Bethany	DWR/DPR	1967
2	San Luis	Reclamation, DWR/DPR	1967
3	O'Neill Forebay	Reclamation, DWR/DPR	1967
4	Millerton	Reclamation/DPR	1942
5	New Melones	Reclamation/Reclamation	1979
6	Camanche	EBMUD/EBMUD	1963
7	New Hogan	Corps/Corps	1963
8	New Don Pedro	TMID/LDPRA	1971
9	Lake McClure	MID/MID	1967
	Rivers and Canals		
10	San Joaquin	NA/Private	NA
11	Stanislaus	NA/Private	NA
12	Tuolumne	NA/Private	NA
13	Calaveras	NA/Private	NA
14	Merced	NA/Private	NA
15	Mokelumne	NA/Private	NA
16	California Aqueduct	DWR/DWR	1968
17	Delta-Mendota Canal	Reclamation/Fresno and Stanislaus County Parks and Recreation Department	
	Wildlife Refuges		
18	San Luis NWR	USFWS/USFWS	1966
19	Merced NWR	USFWS/USFWS	1951
20	Volta WMA	Reclamation/DFG	1952
21	Los Banos WMA	DFG/DFG	1929

NOTES:

Corps = U.S. Army Corps of Engineers.
DFG = California Department of Fish and Game.
DPR = California Department of Parks and Recreation.
DWR = California Department of Water Resources.
EBMUD = East Bay Municipal Utilities District.
LDPRA = Lake Don Pedro Recreation Agency.
MID = Merced Irrigation District.
NA = Not applicable.
NWR = National Wildlife Refuge.
Reclamation = U.S. Bureau of Reclamation.
USFWS = U.S. Fish and Wildlife Service.
TMID = Turlock-Modesto Irrigation District.
WMA = Wildlife Management Area.

SOURCES:
California Department of Finance 1991; Reclamation 1989, 1993a.

Table 22. Potentially Affected Recreation Areas in the San Joaquin River Region

The Tuolumne River historically supported a significant trout fishery in the upper coldwater reaches of the river. Rainbow, brown, brook, and golden trout ranged as far downstream as the present location of New Don Pedro Reservoir. Largemouth and smallmouth bass, bluegill, white catfish, and other warmwater fish species were common in the lower foothill and valley reaches of the river (Jones & Stokes Associates 1976). Before impoundment of the lower reach, the Tuolumne River supported steelhead and annual chinook salmon runs of up to 100,000 fish (Jones & Stokes Associates 1976). No information or use data on angling or nonconsumptive recreation before the construction of New Don Pedro Reservoir have been located.

The Merced River historically supported populations of spring- and fall-run chinook salmon that averaged 12,000 fish per year. The salmon run on the Merced River declined and was in poor condition for at least 20 years before the construction of Lake McClure. Operation of the dam has improved the preproject flow conditions, and salmon habitat improvement projects have effectively maintained chinook salmon populations (Jones & Stokes Associates 1976). As with other rivers in the San Joaquin River Region, the Merced River also supported an unknown number of dispersed water- dependent and water-enhanced recreation pursuits, such as swimming, boating, camping, and picnicking.

No recreation or fisheries data are available for the Calaveras River before the construction of New Hogan Lake. Recreation activities are assumed to be similar to those of other rivers in the region.

Overall, recreation use at important reservoirs, rivers, and wildlife refuges in the San Joaquin River Region has been increasing since the 1940s. Consequently, recreation expenditures and benefits associated with increased use by visitors to the recreation areas have been increasing and have become an important contributor to local and regional economies.

CURRENT RESOURCE CONDITIONS

RECREATION LAND USE

Land uses in the San Joaquin River Region are predominantly open space in the mountain and foothill areas, and agricultural in the San Joaquin Valley area. The Sierra Nevada Range includes the Eldorado, Stanislaus, and Sierra National Forests, and Yosemite National Park. Public lands amount to about one-third of the region. The region's foothills border Kings Canyon and Sequoia National Parks and Sierra National Forest.

RECREATIONAL OPPORTUNITIES

Major lakes and reservoirs in the San Joaquin River Region are San Luis Reservoir, Millerton Lake, New Melones Reservoir, Lake McClure, and New Don Pedro Reservoir (Table 22). Major rivers in the region include the San Joaquin, Merced, Tuolumne, and Calaveras. Other potentially affected lakes and reservoirs in the region include Bethany Reservoir, O'Neill Forebay, New Hogan Lake, Camanche Reservoir, and other reservoirs located upstream of major reservoirs.

The San Joaquin River Region includes federal and state wildlife refuges and private hunting clubs, and the SWP's California Aqueduct and Reclamation's Delta-Mendota Canal provide limited recreation opportunities in the region. Wildlife refuges in the San Joaquin River Region provide both consumptive and nonconsumptive recreation opportunities. Nonconsumptive recreation opportunities, which include wildlife viewing, are provided at San Luis, Merced, and Kern NWRs, and Volta and Los Banos WMAs. Consumptive recreation opportunities, which include fishing and waterfowl hunting, are provided at Volta and Los Banos WMAs and Kern NWR. Use data for these refuges are shown in Table 23.

Use Type[a]	1986	1987	1988	1989	1990	Average Annual Use
Noncon-sumptive	22,325	26,456	32,537	30,293	35,695	33,413
Consumptive						
Hunting	11,810	13,535	11,511	9,890	11,132	11,536
Fishing	3,408	4,380	4,064	3,686	4,246	4,291
Subtotal	15,218	17,915	15,575	13,576	15,378	15,826
Total	**37,543**	**44,371**	**48,112**	**43,869**	**51,073**	**49,239**

NOTES:

Because no data are available for San Luis and Merced NWRs in 1983 and San Luis NWR in 1984, average annual use is based on 1985 through 1990 data.

[a] Use is reported in number of visits.

SOURCES:
Cortese and Miller pers. comms.

Table 23. Use at Major Wildlife Refuges in the San Joaquin River Region

The recreation characteristics of these sites and the use and activities at each are listed in Tables 24 and 25, respectively.

FISH, WILDLIFE, & RECREATION ECONOMICS

In 1992, recreation use at major reservoirs, rivers, and wildlife refuges in the San Joaquin River Region totaled approximately 2.9 million RVDs. Recreation benefits associated with use at the popular recreation areas in the San Joaquin River Region in 1992 are estimated at $36.4 million (Table 25). Trip-related expenditures resulting from this use reached an estimated $56.8 million (Table 26).

Environmental Setting - CVP and SWP Service Areas Outside the Central Valley

HISTORICAL PERSPECTIVE

Development of the SWP and CVP created recreational opportunities at facilities constructed outside the Central Valley. Use of these facilities has generated spending in local economies and benefits for recreationists. Most of the recreational use of SWP and CVP facilities has been centered around storage reservoirs.

Since 1960, development of SWP has resulted in the construction of 29 storage facilities in various locations of the state. Similarly, development of the CVP resulted in the construction of several dams and reservoirs in the state between the 1930s and 1960s. Reservoirs are located in northern and southern California.

In southern California, Castaic, Pyramid, Silverwood, and Perris lakes provide recreational opportunities. Spending and benefits have increased as use has grown in relationship to population growth in northern and southern California.

The development of SWP and CVP Service Areas Outside the Central Valley has steadily increased since the 1880s. Since the 1970s, suburban sprawl has grown to comprise the majority of coastal and inland valley land uses. Open space uses, including national forest and park lands, and state parks and recreational areas, historically have comprised about one-third of the region.

CURRENT RESOURCE CONDITIONS

RECREATION LAND USE

The Los Padres National Forest provides recreation and open space land uses in the SWP and CVP Service Areas Outside the Central Valley.

Most of the region's coastal plains and valleys are densely populated. Open space includes the Angeles, San Bernardino, and Cleveland national forests, as well as the Santa Monica Mountains and other inland areas. Other open space exists in the form of coastal wetlands and lagoons. Prominent rivers include the Santa Clara, Los Angeles, San Gabriel, Santa Ana, Santa Margarita, and San Luis Rey.

Recreation Areas	Surface Area (acres or miles)	Number of Key Facilities: Marinas	Boat Launches	Picnic Areas	Camp-grounds	Swimming Areas	Activity Restrictions	Primary Game Fish
Key Areas								
Reservoirs and Lakes								
San Luis	12,700	0	2	0	1	0	Waterskiing limited	BB/CF/SB
Millerton	4,920	1	6	6	1	2	Boat speed restrictions	C/RT/SB/STB
New Melones	3,580	1	10	2	2	1	None	NA
McClure	7,100	3	6	3	2	3	None	BB/BG/LB
New Don Pedro	13,000	2	3	1	3	1	None	BG/C/CF/RT/SB
Rivers								
San Joaquin	100	1	0	3	0	0	Activity restricted on private lands	CF/SB
Merced	50	0	0	4	2	0	Activity restricted on private lands	CF/SB
Tuolumne	50	0	0	3	0	0	Activity restricted on private lands	CS
Stanislaus	60	0	1	10	1	0	Activity restricted on private lands	C/CF/LB/SB
Wildlife Refuges[a]	18,600	0	0	0	0	0	Limited access during waterfowl season	CF/SB
Private Hunting Clubs[b]	96,842	0	0	0	0	0	None	NA
Other Potentially Affected Areas								
Reservoirs and Lakes								
Bethany	160	0	1	2	0	0	Boat speed restrictions	CF/STB
O'Neill Forebay	2,700	0	2	2	1	1	None	BB/CF/STB
New Hogan	4,400	1	4	2	4	2	Boat speed restrictions	BB/BG/C/CF/GS/STB
Camanche	7,700	2	3	0	2	0	Waterskiing limited	BT/C/CF/LB/RT/S/SB
Rivers, Aqueducts, and Canals								
Mokelumne	40	0	0	1	0	1	Activity restricted on private lands	AS/CS/SH/ST
Calaveras	45	1	1	1	0	0	Activity restricted on private lands	AS/CS/SH/ST
California Aqueduct[c]	340	0	0	0	0	0	No water contact	BG/C/CF/GS/LB/SF/STB
Delta-Mendota Canal[d]	200	0	0	0	0	0	No water contact	STB/CF

NOTES:

Fish species code letters are:

AS	=	American shad	GS	=	green sunfish
BB	=	black bass	LB	=	largemouth bass
BG	=	bluegill	NA	=	no information currently available
BT	=	brown trout	RT	=	rainbow trout
C	=	crappie	S	=	sturgeon
CF	=	catfish	SB	=	smallmouth bass
CS	=	chinook salmon	STB	=	striped bass

[a] Wildlife refuges are San Luis NWR (7,400 acres), Merced NWR (2,600 acres), Volta WMA (3,000 acres), and Los Banos WMA (5,600 acres). Fishing at refuges is allowed only on the San Luis NWR.

[b] Approximately 176 private hunting clubs are located throughout the San Joaquin River Region.

[c] The California Aqueduct has 12 fishing access sites.

[d] The Delta-Mendota Canal has two fishing access sites.

SOURCES:

Reservoirs and Lakes:
- San Luis: DWR 1989.
- Millerton: DPR 1989.
- New Melones: Butterbaugh pers. comm.
- McClure: Merced Irrigation District 1993.
- New Don Pedro: Don Pedro Recreation Agency n.d.
- Bethany: DWR 1989.
- O'Neil Forebay: DWR 1989.
- New Hogan: Corps 1992b.
- Camanche: YCWA 1993, BioSystems Analysis 1992.

Rivers, Aqueducts, and Canals:
- San Joaquin: DPR 1990, Jones & Stokes Associates 1976.
- Merced: Rodriquez pers. comm.
- Tuolumne: DPR 1990.
- Stanislaus: Jones & Stokes Associates 1976.
- Mokelumne: Moranton pers. comm., DFG 1991b.
- Calaveras: Jones & Stokes Associates 1988.
- California Aqueduct: DFG 1984.
- Delta-Mendota Canal: Reclamation 1993a.

Wildlife refuges: USFWS 1983, 1991, and 1992b; Kie pers. comm.
Private hunting clubs: DFG 1994.

Table 24. Recreation Characteristics of Potentially Affected Recreation Areas in the San Joaquin River Region

Recreation Areas	Use[a,b] (1,000)	Water-Dependent Activities (%)					Water-Enhanced Activities (%)					
		Power Boating	Other Boating	Fishing	Water-skiing	Swim-ming and Beach Use	Camp-ing	Picnick-ing	Relax-ing/ Sight-seeing	Resorts	Other	Total
Key Areas												
Reservoirs and Lakes												
San Luis	210	4	--	34	--	3	14	11	20	--	14	100
Millerton	316	7	--	2	6	6	5	--	74	--	--	100
New Melones	498	64	--	--	--	--	36	--	--	--	--	100
Lake McClure	606	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
New Don Pedro [c]	280	--	--	--	--	--	28	--	--	--	72	100
Rivers[d]												
San Joaquin [e]	157	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Merced [f]	109	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Tuolumne [g]	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Stanislaus	122	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Wildlife Refuges [h]	56	--	--	7	--	--	--	--	71	--	22	100
Private Hunting Clubs [i]	241	--	--	--	--	--	--	--	--	--	100	100
Other Potentially Affected Areas												
Reservoirs and Lakes												
Bethany	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
O'Neill Forebay	417	7	--	17	--	22	6	15	22	--	11	100
New Hogan	185	24	--	11	15	17	12	8	8	--	5	100
Camanche	258	--	--	--	--	--	40	--	--	--	60	100
Rivers, Aqueducts, and Canals												
Mokelumne [j]	18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Calaveras	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
California Aqueduct	61	--	--	100	--	--	--	--	--	--	--	100
Delta-Mendota Canal [k]	23	--	--	100	--	--	--	--	--	--	--	

NOTES:

-- = No use reported in these categories.
NA = No information currently available.

[a] Use at all reservoirs is reported in 12-hour RVDs, at all rivers is reported in 6-hour RVDs, and at all wildlife refuges and private hunting clubs is reported in 5-hour RVDs.
[b] Annual use is for 1992, except Bethany Reservoir (1991) and California Aqueduct (1991).
[c] Water-dependent activities at New Don Pedro Reservoir account for 72% of use.
[d] Reported use is for boating, fishing, swimming, and wildlife viewing activities only.
[e] San Joaquin River use estimates are for Fremont Ford SRA, Las Palmas Fishing Access Site, Mossdale Landing County Park, and Don Reis County Park.
[f] Merced River use data are for McConnell and George J. Hatfield SRAs, Hageman County Park, and Henderson County Park.
[g] Tuolumne River use estimates are based on a 1980 survey adjusted using 1992 population levels.
[h] Wildlife refuges are San Luis NWR, Merced NWR, Volta WMA, and Los Banos WMA.
[i] Approximately 176 private hunting clubs are located throughout the San Joaquin River Region.
[j] Mokelumne River use data are for the Mokelumne River Day Use Area.
[k] Access to the Delta-Mendota Canal is limited to access sites Nos. 2A and 5.

SOURCES:

Reservoirs and Lakes:
- San Luis: use (Reclamation 1992a), activity (DWR 1987).
- Millerton: use (Reclamation 1992a), activity (Reclamation 1986).
- New Melones: use (Reclamation 1992a), activity (Davis pers. comm.).
- McClure: use (Ardohain pers. comm.).
- New Don Pedro: use and activity (Cornell pers. comm.).
- Bethany: use (Erba pers. comm.).
- O'Neill Forebay: use (Reclamation 1992a), activity (DWR 1987).
- New Hogan: use and activity (Lykins pers. comm.).
- Camanche: use and activity (Hill pers. comm.).

Rivers and Canals:
- San Joaquin: use (DPR 1990).
- Merced: use (DPR 1990).
- Tuolumne: use (DPR 1990).
- Stanislaus: use (DPR 1990).
- Mokelumne: use (Moranton pers. comm.).
- California Aqueduct: use (Higley pers. comm.), activity (DWR 1989).
- Delta-Mendota Canal: use (Reclamation 1992a), activity (Reclamation 1993b).

Wildlife refuges: use (Murczek pers. comm., DFG n.d.), activities (USFWS 1990).
Private hunting clubs: (DFG 1992).

Table 25. Recreation Use and Activities at Potentially Affected Recreation Areas in the San Joaquin River Region

Recreation Area	Regional Expenditure[a] (millions of 1995 dollars)	Benefits[b] (millions of 1995 dollars)
Reservoirs and Lakes		
CVP Reservoirs		
San Luis	5.1	2.2
Millerton	5.4	3.3
New Melones	8.4	5.2
Non-CVP Reservoirs		
McClure	10.2	6.3
New Don Pedro	4.7	2.9
New Hogan	3.7	2.0
Camanche	4.3	2.7
Rivers[c]		
San Joaquin	4.9	3.0
Merced	3.3	2.2
Tuolumne	2.9	2.9
Stanislaus	2.6	2.4
Wildlife Refuges	1.3	1.3
Total	**56.8**	**36.4**

NOTES:

Expenditures and benefits are estimated from 1992 use information.

[a] Includes 80% of expenditures made by visitors from outside the region and 100% of expenditures by visitors from inside the region.

[b] Measured in terms of users' net willingness to pay for recreation opportunities.

[c] Includes fishing, boating, swimming, and wildlife viewing activities.

Table 26. Estimated Expenditures and Benefits Related to Recreation Use at Important San Joaquin River Region Recreation Areas

Portions of Kern, Los Angeles, and San Bernardino Counties are a closed basin with many desert valleys and small mountain ranges.

The southern portion of San Bernardino County, the middle portion of Riverside County, and the Salton Sea in Imperial County have an arid climate; however, the area contains many productive agricultural areas and vacation resorts. Vacation and resort facilities in these areas include hotels, country clubs, golf courses, and other residential communities. Federal and state government-owned lands in this area include military facilities (U.S. Marine Corps Training Center at Twentynine Palms) and major parks (Joshua Tree National Monument).

RECREATIONAL OPPORTUNITIES

In the SWP and CVP Service Areas Outside the Central Valley, several reservoirs, lakes, and aqueducts provide facilities for anglers, boaters, picnickers, campers, and cyclists. Use levels are generally higher at reservoirs in southern California. Recreational facilities at Castaic, Pyramid, Silverwood, and Perris lakes include boat ramps, marinas, swim beaches, picnic areas, and camping areas. Additionally, fishing is allowed along many miles of the California Aqueduct.

FISH, WILDLIFE, & RECREATION ECONOMICS

Use of key recreation facilities in the SWP and CVP Service Areas Outside the Central Valley totaled approximately 3.1 million RVDs in 1992 (Higley pers. comm.), which resulted in an estimated $132 million in trip-related spending based on average spending per day of $42.57. Recreational spending and benefits generated by use of reservoirs in the SWP and CVP Service Areas Outside the Central Valley also are higher at reservoirs in southern California.

Annual recreation benefits associated with these activities are estimated at $122.0 million per year, based on an average benefit of $39.10 per day for reservoir recreation.

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